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A paradigm shift in imaging for renal colic – Is it time to say good bye to an old trusted friend?

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ABSTRACT

Objectives: To study the changing pattern in the use of intravenous urogram (IVU) and non-contrast enhanced CT (CTKUB) for evaluation of flank pain at a single centre.
Methods: All patients who underwent either an IVU or CTKUB at a single, tertiary care center from January 2002 to December 2007 were retrospectively identified from the radiology database. Study samples were-divided into two groups: Pediatric (14 years or less) and Adult (greater than 14 years). For each group, overall trends as well as trends across referral setting and gender were explored by plotting line graphs using SPSS version 15.
Results: During the study period a total of 11245 uro-radiological examinations were performed using either IVU (43.7%, $n = 4915$) or CTKUB (56.3%, $n = 6330$). A remarkable majority of procedures (95.5%, $n = 10741$) was performed in adult patients. Overall, the respective proportions of IVU and CTKUB were 87.9% ($n = 43$) and 12.1% ($n = 61$) in the pediatric group whereas 41.6% ($n = 4472$) and 58.4% ($n = 6269$) in adults. Majority in both groups were ambulatory patients (Pediatrics 83.7%, Adults 76.7%). During 2002–20007, the yearly proportion of CTKUB increased from 27% to 80% in adults and from 3% to 27% in children.
Conclusions: There is major shift in the choice of imaging in adults from IVU to CTKUB during years 2002–2007. In pediatric patients, IVU referrals still comprise the greater proportion of uro-radiological exams.

1. Introduction

Renal colic, with an estimated lifetime prevalence of 12%[1] is a common reason for presentation to the emergency department and urology clinics.[2,3] Most of these cases are attributable to urinary calculus[1] which is a highly recurrent condition with the 10-year recurrence rate exceeding 35%.[3,4]

Radiological imaging is crucial not only in diagnosis but also in making therapeutic decisions in patients with urolithiasis. The available options include plain radiograph KUB, IVU, CTKUB, US and the more sophisticated MR Urography.[2,3] For decades, IVU has dominated the diagnostic algorithms for acute flank pain but, more recently, CTKUB has emerged as a tough competitor.[3,5] Evidence in favor of CTKUB is growing by the day; complete replacement of IVU with CTKUB seems imminent.

The choice of imaging modality should be based on its accuracy, safety, cost-effectiveness, availability, adaptability and ease of interpretation.[3,6] Diagnostic yield, radiation dose and time-to-diagnosis remain constant across developed and developing countries as well as across public- and private-funded health care systems. However, the same cannot be presumed about availability and cost of the diagnostic services or of the required human resources. A clinician weighs all these aspects, and their overall clinical impact, before making a referral for either modality. Consequently, the diagnostic preferences may differ across diverse health care systems.

We analyzed the trends of referral for uro-radiological studies, over a period of six years, at a single tertiary care centre, in a developing country with a predominantly private-funded health care system. We hope that our findings will assist in pragmatic planning of the diagnostic facilities for these patients.

2. Methods

The study was conducted at a 600 bedded tertiary care University Hospital. The department of Radiology provides services

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to hospitalized patients (HP) as well as those under care of the Emergency department (ED) of the hospital. In addition, ambulatory patients (AP) are referred from both hospital affiliated clinics and independent health care providers.

This is a retrospective cross sectional study in which all patients who underwent either CTKUB or an IVU examination from January 1, 2002 until December 31, 2007 were included. Only those patients who had CTKUB examination done with intravenous contrast examination were excluded. No other exclusion criteria present in our study. The referring decision was made by primary clinicians in all cases.

Records of all IVU and CTKUB performed during a given period were retrieved from the Radiology Information System. Both these procedures were performed, after informed consent, on patients with renal colic and a high suspicion for urolithiasis, upon discretion of the referring physician. The corresponding age (0–14 years = Pediatric; >14 years = Adult) and gender of patient as well as the practice location (ED, HP and ambulatory patients) and specialty (urology, surgery and allied and medicine and allied) of referring physician were documented for each exam.

Statistical Package for Social Sciences (version 15) was employed for data entry and analysis. The study sample was divided into two age groups viz. pediatric (up to 14 years) and adult (greater than 14 years). Frequency tables were used for descriptive statistics. Line graphs were plotted to explore the trends of referrals for each group, on the whole and across venues of referral.

3. Results

During the study period a total of 11,245 uro-radiological examinations were performed using either IVU (43.7%, $n = 4915$) or CTKUB (56.3%, $n = 6330$). A remarkable majority of procedures (95.5%, $n = 10741$) were performed in adult patients as compared to children (4.5%, $n = 504$).

Of those undergoing CTKUB, 68% ($n = 4290$) were males and 32% ($n = 2040$) were females whereas the respective proportions were 63% ($n = 3097$) and 37% ($n = 1818$) in case of IVU. Mean age of the patients who had a CTKUB performed was 39.8 ± 14.8 years, compared to 36.3 ± 16.5 years for those who had an IVU ($p < 0.001$, two-tailed t-test). Overall, the respective proportions of IVU and CTKUB were 87.9% ($n = 43$) and 12.1% ($n = 61$) in pediatric group whereas 41.6% ($n = 4472$) and 58.4% ($n = 6269$) in the adults.

The year-wise distribution (Fig. 1) indicates that the respective numbers of CTKUB and IVP were 423 (26%) and 1263 (74%) in year 2002; 627 (38%) and 1025 (62%) in year 2003; 1023 (53%) and 892 (47%) in year 2004; 1217 (63%) and 699 (37%) in year 2005; 1469 (72%) and 580 (28%) in year 2006 while 1571 (77%) and 456 (23%) in year 2007.

Based on referral location the majority of both examinations were referred from clinics as AP comprising 77% cases ($n = 8658$) followed by ED which is 12.7% ($n = 1428$) and least numbers ordered from HP 10.3% ($n = 1159$).

Referring specialty-wise, most of the cases were referred from urology clinic during the study period with total number of 5788 (51.5%). The second largest group comprised those referrals where the referring physician could not be identified, and were therefore excluded from further analysis of trend by specialty. It comprises 2954 (26.3) patients followed by referrals from medicine and allied department 1937 (17.2%) and 566 (5%) patients were sent by surgery and allied group.

In the pediatric population, very limited numbers of CTKUB were undertaken ranging from 3 to 20 scans per year with a mean of 10 scans, and shows an approximately 20% increase in referrals in the year 2007 as compared to year 2002 and on the other hand IVU which is a highly recommended modality in this age group shows an almost 25% decrease in referrals in the respective years. This trend was from hospital affiliated clinics. The number of IVU ordered from ED was nil however CTKUB remains the referring modality of choice from ED. Decreasing IVU referrals seen from AP (outside referrals) and HP in which there is significant decline in referrals seen since 2006 with an almost 40% decrease noted while CTKUB shows an approximately 40% increase in the same period. Significant and steep decline in IVU referrals were seen from medicine and allied group where there is an approximately 70% decrease noted since mid-2004. This is followed by urology where an almost 50% decline of IVU referrals were seen from 2002 onwards. From both referral locations CTKUB is on the rise with significant change of referral trends noted from medicine and allied group with an approximately 75–80% rise in the year 2007. However IVU remains the modality of choice for surgery and allied group with no significant change in referral pattern throughout this period and very minimal number of CTKUB were referred from this location and these do not show any rise.

In the adult group, however, there is significant change seen during the study period with a significant rise in CTKUB and decline in IVU referrals in all almost all referring locations and specialties. The number of IVU ordered from ED was almost nil with maximum number ($n = 2$) referred in 2003 and is comparable to pediatric age group, on the other hand CTKUB was again the modality of choice in adults from ED. The significant difference between the adult and pediatric age group comes in respect to referral locations where in comparison there is significant decline in IVU and rise in CTKUB seen in AP (hospital affiliated clinics) and HP where major decline seen in 2004 and mid-2002, respectively with continuous fall and rise in these modalities. However in one of the subgroup of AP (i.e. outside referrals) there was a significant initial change noted starting from 2002 until 2004 from there onwards there is a plateau noted in the referrals of both modalities share almost 50% referrals till the year 2007. From specialty-wise significant rise in CTKUB referrals noted in all groups with maximum change in medicine and allied group.

The year-wise distribution for each age group with regard to gender and referral setting are given in Table 1. The comparative trends of CTKUB and IVU referrals are illustrated in Fig. 1(a–c).

4. Discussion

This six-year comparison of referral trends for acute flank pain revealed a remarkable shift from IVU to CTKUB for the adult patients. But IVU still comprises about a quarter of yearly exams in adult ambulatory patients. In addition, IVU has maintained its position as the preferred diagnostic choice in the pediatric age group.

Acute flank pain is a common and often confusing clinical problem which might be caused by a variety of urinary and extra urinary abnormalities with ureterolithiasis being the most frequent cause. Until recently, Plain abdominal radiographs combined with ultrasound and IVU have been the standard imaging procedures for the evaluation of acute flank pain. The utility of IVU may be potentially hampered by poor quality due to lack of bowel preparation, by nephrotoxicity of contrast agents, by serious allergic and anaphylactic reactions and by significant radiation exposure.

Whitfield and Whitfield[6] recommend that the diagnostic imaging in urology should be accurate, safe, economical, available, adaptable and easy to interpret. Over the last 80 years, IVU has played a major role in the work-up of the upper urinary diseases. In a comparison of the cost and accuracy of multidetector computed tomography (MDCT) and intravenous urography (IVU), to establish the most cost-effective initial investigation for acute renal colic, Eikefjord et al.[7] calculated that when expenses of equipment,