Has the time come to write the EPITAPH for the intravenous urogram?

DR ANIRUDH KOHLI
Jt. Editor & Secretary

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As decades roll by and technology changes, some techniques loose their importance and relevance's. Newer technologies replace older technologies, as the newer techniques are more accurate, sensitive, specific, less invasive or cheaper. Techniques such as pnuemoencephalography, retroperitoneal insufflations of air are examples of old technologies, which have been totally replaced and now listed only in the archives of medicine. Bronchography, myelography and perfusion/ ventilation scans are more recent examples of procedures which have been replaced by less invasive newer imaging modalities. During their time these procedures for the lack of a more appropriate procedure served humanity and helped in the diagnostic work up. In recognition of their service, in their time of need, it is only appropriate to write an epitaph, so as to chronicle the virtues of this technology, more than merely as a remembrance.

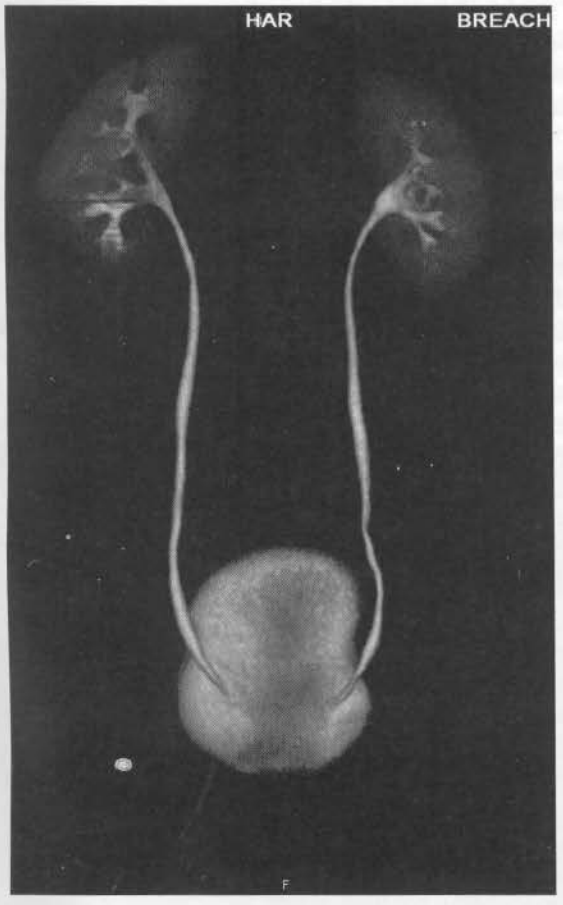
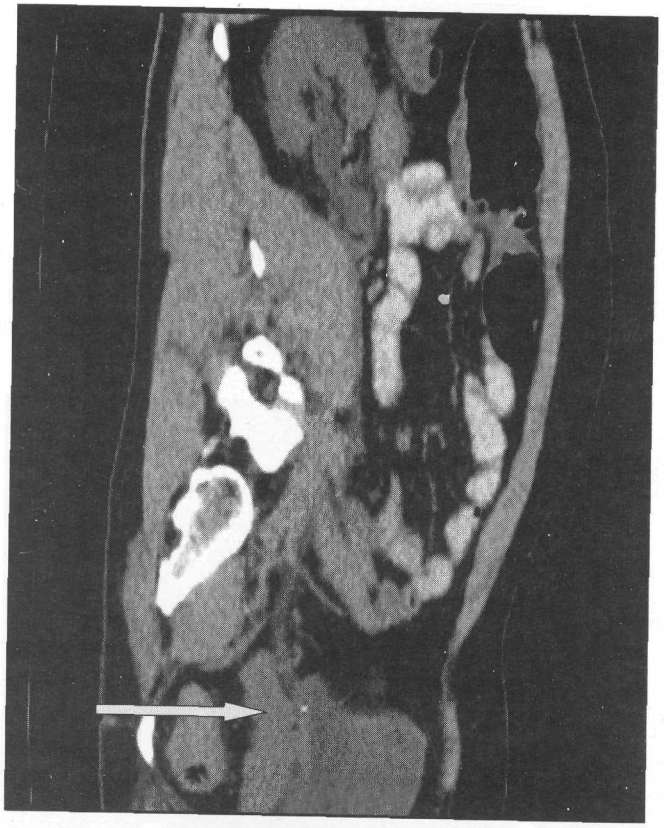


Figure 1 CT Urogram VRT image

The intravenous urogram, a procedure utilized for visualizing the urinary tract from the time of discovery of contrast agents is on the brink of extinction.

Fig2 MDCT Urogram : Terminal ureteric calculus causing obstruction to terminal right ureter. Note small calculi in lower pole left kidney.

Fig 3 CT Urogram demonstrating left lower ureteral calculs with hydroureter. Distal ureter below calculus is visualised



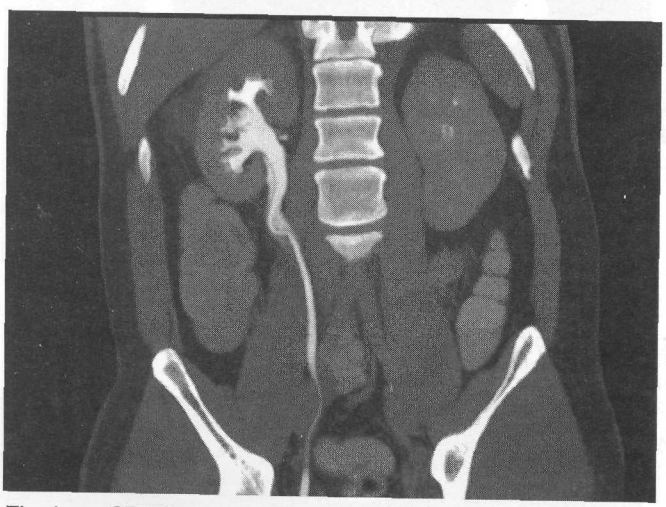


Fig 4 a : CT Urogram demonstrating perirenal stranding due to obstruction. Fig 4b Contrast urogram : demonstrating pelvicalyceal and periureteric leak of contrast due to back pressure changes.

Has the time come to write the epitaph of the intravenous urogram?

In the early years the intravenous urogram was the modality to evaluate every aspect of the kidney and urinary tract. Soon sonography came along; this modality took up its fair share of applications for evaluating the urinary system, space occupying lesions, hydronephrosis, renal calculi etc. Nearly 2-3% of the entire human population will develop a renal colic during their life time. Sonography has a high sensitivity for renal calculi, but its sensitivity for ureteral calculi is low. It is also not able to depict function, the calyceal system and ureters well. The plain KUB lacks specificity in detecting renal calculi, as phleboliths may simulate calculi. Plain radiographs are also unable to demonstrate radiolucent calculi. The intravenous urogram has been the main imaging modality for evaluation of ureteral calculi, indivuals with flank pain and the work up of haematuria. It has its share of limitations, inability to effectively visualize radiolucent calculi; quality of images may be degraded by bowel gas, bowel contents or impaired renal function. Spiral CT has an extremely high sensitivity in detecting renal and ureteric calculi. Spiral CT in fact is the modality of choice for evaluating flank pain. (1) It has a higher sensitivity in detecting ureteral stones as compared to the IVU; it has a similar accuracy in demonstrating obstruction as the IVU. Limitations of plain spiral CT have been its inability to differentiate calculi from phleboliths. Administration of intravenous contrast medium would be required in these situations to define the ureters so as to determine whether the calcific density was a ureteric calculus or a phlebolith. Clinicians have still preferred the conventional IVU, more from the perspective that the IVU is a projection image, which they are familiar with as compared to axial CT images, which they are unfamiliar with. Multidetector CT machines are now able to provide contiguous slices of 0.5-0.75 mm. Panning through the axial images, it is possible to trace the unenhanced ureters in most cases. A dilated ureter is always traceable. In most cases the non-dilated ureter is also traceable. A MPR reconstruction of the images is then possible thus providing an unenhanced urogram. In cases where there is a difficulty in tracing the ureters a small volume of contrast material may be used to outline the ureters. The main information clinicians look for in indivuals with flank pain is

1) Is there a ureteric calculus
2) Size of the calculus ; most calculi less than 5 mm pass easily
3) What is its level : to help determine the intervention
4) Is there obstruction
5) Extent of back pressure changes
6) If possible status of ureter distal to calculus

All this information is available on both an IVU and a MDCT study. Then which would we prefer. The sensitivity of MDCT is superior to an IVU for ureteric calculi. MDCT is a quick exam of 30 seconds, occasionally extended by 10 min if contrast is used as compared to IVU which can range from 25-45 minutes. Since only a small quantity of dye is used and table time is minimal most MDCT users are matching or actually charging less than what an IVU costs. The only other issue is radiation dose. In MDCT without contrast the dosage is less than that of an IVU. (2) With contrast the dosage is 1.5 times that of IVU. (3) Low ma protocols are being advocated to reduce the radiation dose below that or match IVU.

An important application of the IVU has been to evaluate urothelial abnormalities especially of the calyces and

urothelial tumors. MPR reconstructions of the pelvicalyceal system with MDCT provide excellent detail of the calyces, renal pelvis, ureters and urinary bladder. Small lesions in the ureter, renal pelvis and bladder are detected better with MDCT. Papillary necrosis due to a variety of causes is an important cause of haematuria. CT Urography demonstrates these changes extremely well as focal areas of contrast collection within or along the periphery of the papilla. In most other applications MDCT Urogram provides more information than the conventional Urogram. This is because MDCT Urogram demonstrates not only the pelvicalyceal system as in conventional urography but also the renal, perirenal and vascular tissues. Examples of these applications are indivuals with renal masses who are slated for nephron sparing surgery. These patients require a precise depiction of tumor and its relation to the collecting system. In indivuals with pelviureteric junction obstruction, the success rate of endopyelotomy depends on whether there are crossing vessels at the uretero pelvic junction. The success rate is only 42% in patients with a crossing vessel and 80% if no crossing vessel. (4) A combination of CT angio with CT Urography demonstrates the crossing vessel in relation to the renal pelvis very well. Similarly in congenital lesions such as retrocaval ureter, not only does CT Urography demonstrate the ureteric compression but also the IVC which is the cause for the retrocaval ureter. Ureteral duplication is another common congenital anomaly; the entire course of both upper and lower moiety must be demonstrated as well as the ectopic opening. Often the upper moiety with a lower ectopic opening is hydronephrotic with a hydroureter. This component is usually non-functioning or has poor function therefore is not visualized on the conventional Urogram. MDCT Urography has the ability to demonstrate both opacified and unopaccified ureters, therefore can demonstrate both functioning and nonfunctioning components. A combination of CT Angiography and CT Urography in renal donors has replaced DSA and IVU in the work up of renal donors.

Fig 5 CT Urogram Two small calculi causing right ureteric obstruction

Fig 6 CT Urogram demonstrating normal ureter distal to obstructing calculus.

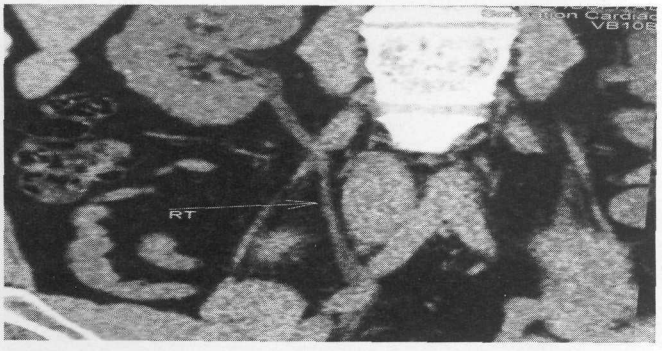


Fig 7ab : CT Urogram demonstrates terminal ureteric calculus, follow up CT urogram demonstrates passage of stone.

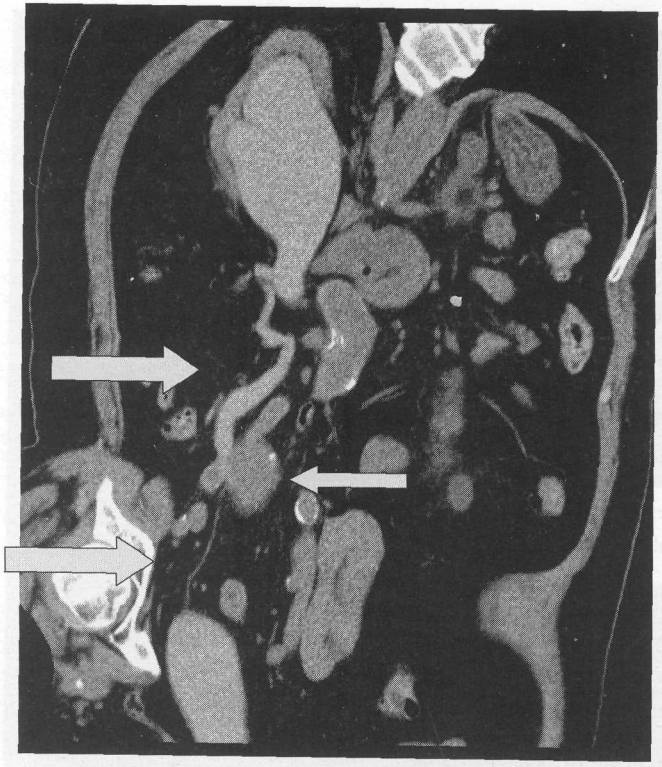


Fig 8 Contrast CT Urogram demonstrates obstructed right ureter by mass lesion - aneurysm of abdominal aorta. Non dilated distal ureter is seen below the compression

CT urography in essence is a quicker modality which is more precise and provides more diagnostic information than the conventional Urogram. In many applications especially the large group of ureteric calculi IV contrast is not required. Therefore there is no doubt wherever MDCT is available, the time to write the epitaph for the IVU has come. As MDCT progressively replaces older technology, alas IVU will be replaced by CT Urography.

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