

OPTIMIZING CT UROGRAPHY: A RADIATION REDUCTION TECHNIQUE

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BACKGROUND

CT UROGRAPHY has become the standard for imaging the kidneys and urogenital tract

- Most protocols utilize either a dual phase or a triple phase approach
- Each phase exposes the patient to a full dose of radiation
- A single phase abdomen/pelvis CT yields an approximate effective radiation dose of 15 mSv (comparable to 5 years background radiation)
- A single CT scan increases a patients lifetime risk of developing cancer.

PURPOSE AND HYPOTHESIS

Studies Dating Back to the mid 1980's have shown the effectiveness of noncontrast CT for detecting urolithiasis and stone related complications.

CT without and with contrast is the established standard for detecting and characterizing renal masses, and as a 'screening' technique for patients with hematuria.

CT UROGRAPHY has the benefit of multiplanar, 3D and virtual reconstructions, along with a variety of techniques for opacifying the urogenital tract to evaluate for both obstruction and uroepithelial lesions. It has also significantly increased radiation exposure.

HYPOTHESIS: *A focused single phase technique will decrease radiation exposure and cancer risk without diminishing diagnostic acumen.*



3D Reconstruction from the noncontrast phase showing multiple renal and ureteral calculi.

MATERIALS AND METHODS

Methods: A retrospective analysis of 297 CT UROGRAMS performed over a three year period was performed. The imaging studies consisted of a noncontrast scan, followed by 50 cc of nonionic contrast, hydration with saline, and a single 20 mg dose of furosemide.

The purpose of the hydration and diuretic is to ensure opacification of the urogenital tract during the actual scan. The initial dose of contrast is given *prior* to imaging, so that there is contrast in the urine during the actual contrast imaging phase. This is the basis for UROGRAPHY, and the reason that Intravenous Pyelography is no longer performed.

After a 20 minute delay, CT was performed with an additional bolus injection of 100 cc nonionic contrast. This bolus not only adds to the diuresis and filling of the collecting system, it also serves to provide an 'enhanced' scan for imaging renal lesions, and to distend the ureters to provide for better 3D and virtual constructions.

Three independent, blinded urologic radiologists interpreted independently the noncontrast, contrast and combined imaging studies. The studies were graded for the presence or absence of renal, ureteral and bladder calculi, benign or suspicious masses, inflammation and obstruction. The results of the combined, two phase UROGRAM (the gold standard) was compared with the results of interpreting the noncontrast phase alone and the contrast phase alone.

RESULTS

STONE DISEASE:

155 renal, 3 ureteral and 10 bladder calculi were seen on the noncontrast study.

98 renal, 3 ureteral and 8 bladder calculi were seen on the contrast study.

All calculi that were not perceived on the contrast study were less than 2 mm.

RENAL MASSES:

182 renal masses were seen on the contrast study, of which 167 were cysts (simple or hemorrhagic), 6 were angiomyolipomas, 3 were suspicious for neoplasm and 6 were indeterminate, but likely hemorrhagic cysts.

147 of the total lesions were seen on the noncontrast study. The noncontrast exam missed 15 cysts, 1 angiomyolipoma, 3 indeterminate lesions and 1 suspicious lesion. The remaining findings matched the contrast study.

The combined exam was able to characterize 5 of the 6 indeterminate lesions as benign hemorrhagic cysts. The contrast study detected 4 suspicious ureteral lesions and 23 suspicious bladder lesions. The noncontrast study missed 3 of the 4 ureteral lesions and 21 of the bladder lesions.

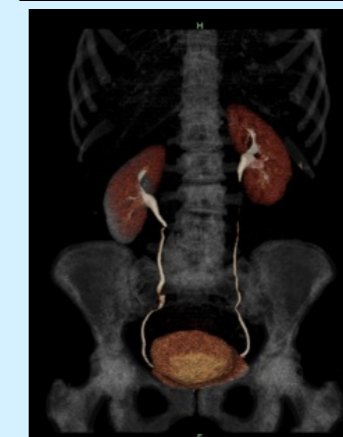


CONCLUSIONS

THE PRECONTRAST PORTION OF CT UROGRAPHY IS NOT ROUTINELY NECESSARY FOR ACCURATE DIAGNOSIS.

In this study, the only time it proved useful was in detecting punctate intrarenal calculi, which are likely not clinically significant, and in helping to characterize indeterminate, dense renal lesions.

292 of our 297 patients could have been *spared* the extra radiation. The remaining 5 could have returned within 24 hours for a noncontrast exam to make a diagnosis of benign hemorrhagic cyst. This would entail patient inconvenience, but no extra radiation.



BIBLIOGRAPHY

Brenner D, Hall E, Computed Tomography- An Increasing Source of Radiation Exposure, NEJM2007; 357: 2277 - 2284

Neitlich T, Thurber M, Optimal CT Technique For Detecting Benign and Malignant Renal Lesions, SBCT/MRI September 2009

