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Diagnostic CT cystography with diluted gadolinium-based contrast: A viable alternative to an iodinated contrast-based cystogram

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A B S T R A C T

Patients with reported history of severe iodinated contrast reaction are not uncommon in daily practice. Iodinated contrast is most frequently administered intravenously (IV) for CT scans but is also used intraluminally during urologic procedures and postoperatively to assess for leaks. Providers often are unaware that patients with prior iodinated contrast allergy after IV administration are still at risk for a reaction during intraluminal administration. We present a case of a patient with history of iodinated severe contrast allergy, in which CT cystography using a gadolinium-based-contrast agent was safely performed as an alternative to iodinated-based-cystography to evaluate for a postoperative leak.

1. Introduction

Adverse reactions to intravascular iodinated contrast can be divided into physiologic and allergic-like reactions. The incidence of these reactions has decreased with use of high-osmolality contrast media.[1] Physiologic reactions occur because of chemotoxicity, osmotoxicity, or due to triggering activators,[1] whereas allergic-like reactions occur similar to allergic reactions. Risk factors for allergic-like reactions are prior similar reactions with a 5-fold increase, history of asthma, renal insufficiency, cardiac disease, and anxiety.[1] Although reactions are most common with intravascular administration of iodinated contrast, intraluminal contrast administration can result in a small amount of intravascular absorption resulting in a reaction. We present a case of utilizing gadolinium contrast for CT cystography to assess for bladder leak in a patient with history of severe allergic-like reaction to iodinated contrast.

2. Case presentation and management

A 79-year-old man with a complex urological history presented with left flank pain and fevers. CT demonstrated a distal left ureteral obstructing stone and severe right hydroureteronephrosis secondary to a right ureterovesical junction stricture. The patient underwent lithotripsy of the obstructing left ureteral stone and robotic assisted right ureteral reimplantation with Boari flap and psoas hitch procedure. No iodinated contrast was used during his urologic interventions at our institution.

As part of a routine postoperative leak evaluation, a fluoroscopic cystogram was ordered. The patient's chart reported a severe reaction to iodinated contrast. The patient was interviewed and described a compelling severe reaction to iodinated contrast reaction after intravenous (IV) administration 15 years previously and had not received iodinated contrast intravenously or intraluminally since that incident. The patient refused the cystogram after being informed that he was still at risk for a contrast reaction, as a small amount of contrast administered into the lumen can be absorbed into the vascular space.

The radiologist and urologist discussed imaging options to assess for a postoperative leak, and the decision was made to attempt a CT cystogram using dilute gadolinium-based contrast agent (GBCA), the contrast agent used for contrast-enhanced MRI.

CT cystogram was performed using 40mL GBCA (gadobutrol 10 mmol/10mL) diluted in 500 mL of normal saline, infused by gravity drip via Foley catheter. There was no preexisting ascites, with simple fluid (less than 20 Hounsfield Units (HU)) in the right renal collecting system and decompressed bladder. 250 mL of the diluted GBCA admixture was instilled retrograde into the bladder until patient had a strong urge to void, then a CT scan was performed from the kidneys through pelvis. The dilute GBCA admixture refluxed from the bladder to the renal calyces, opacifying the vesicoureteral anastomosis (Fig. 1). The collecting system was uniformly opacified, with an attenuation of 376–398 HU, much higher than the attenuation of water and urine (0 HU). The patient had no adverse events and the CT cystogram confidently excluded an anastomotic leak (Fig. 2).

3. Discussion

Allergic-like reactions to iodinated contrast media are uncommon,

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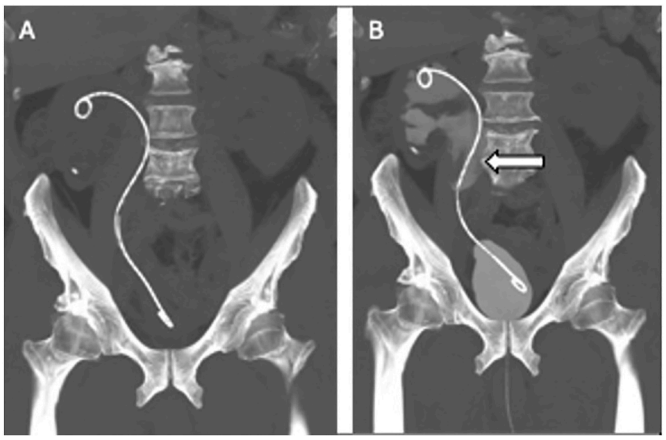

Fig. 1. Coronal MIP images before and after administration of contrast. A) Coronal unenhanced CT MIP image prior to intravesical contrast administration. B) CT cystogram coronal MIP after intravesical dilute GBCA administration via Foley catheter shows contrast opacifying the anastomosis (arrow) and no leak.

with incidence reported as low as 0.6 % aggregate.[1] However, documentation regarding the type of reaction and type of contrast agent used is often incomplete and inaccurate, and safely imaging patients with a reported history of a severe iodinated contrast reaction can be a clinical conundrum.[2] Adverse reactions to iodinated contrast following intraluminal administration (for example, the gastrointestinal and genitourinary tracts) are far less common than those following intravenous administration. However, while only a small amount of iodinated contrast administered into a lumen is absorbed into the vascular space, this absorbed contrast can still trigger an adverse reaction. Given that many allergic-like reactions are not dose-related and severe reactions can occur with as little as 1mL intravascular administration/absorption, nonvascular iodinated contrast is not necessarily considered safe in patients with history of severe reactions. There is limited data regarding adverse reaction rates after intraluminal contrast administration in a patient with prior reaction after receiving intravenous contrast.

Premedication (steroids and diphenhydramine) is the mainstay for prevention of a repeat allergic-like reaction prior to repeat IV iodinated contrast administration in patients with a known prior adverse reaction.[1,3,4] However, it should be noted that efficacy of premedication in reducing moderate to severe reactions has not been confirmed by prior randomized control trials.[5–7]

Contrast agents are used in CT to increase the attenuation or "brightness" of a structure. Iodine's atomic number of 53 makes iodinated contrast an excellent agent to use in CT and x-ray. GBCAs are contrast agents used in MRI due to their local effects on the magnetic properties of adjacent tissues. However, gadolinium's atomic number of 57 results in GBCAs being visible on a CT as well, making a GBCA-based CT cystogram a viable alternative for imaging this patient with a history of a severe iodinated contrast allergy. The concentration of gadolinium in a GBCA is far less than the concentration of iodine in an iodinated contrast agent, and therefore the bladder will be less attenuating in a GBCA-based CT cystogram and difficult to see on a fluoroscopic cystogram, but as illustrated in our case, the bladder attenuation with a GBCA-based CT cystogram is adequate for diagnosis.

Adverse events to GBCA after IV administration are rare. The estimated aggregate incidence of allergic-like reactions to GBCAs is 0.01–0.02 %.[1,8] Other adverse events to GBCAs such as nephrogenic systemic fibrosis are also extremely rare and are documented to occur after IV administration.[9,10] There is limited data on the safety of GBCAs after intraluminal administration. However, it should be noted that the quantity of GBCA used for intraluminal administration is less than IV administration, with less IV absorption.

The literature regarding use of gadolinium as a nonvascular CT contrast agent was surprisingly sparse, particularly for postoperative cystography to evaluate for leaks. Our starting point was a 2008 Urology article from Newport et al., in which the authors diluted GBCA (Omniscan, 20mL) in 500mL normal saline via gravity drip through Foley catheter.[11] Their study was diagnostic in the context of a large leak via a 7 mm rent from a surgically augmented neurogenic bladder. The image quality was fair, but the maximum density of their diluted gadolinium (44 HU) would make confidently excluding a leak more difficult with their protocol.

We present CT cystography using dilute GBCA as a viable alternative to iodinated contrast-based CT cystography in patients who need an intraluminal examination urgently but have a contraindication to iodinated contrast. The concentration of the diluted GBCA was higher for our case than for Newport et al., resulting in higher attenuation of the contrast agent in the lumen, improving image quality. The urinary bladder's smaller capacity allowed the dilute GBCA to remain concentrated in the lumen; this technique might be more difficult when evaluating bowel, both due to bowel's larger capacity and the contrast's ability to progress distally.

4. Conclusions

Diluted GBCA provided diagnostic image quality for CT cystogram in a patient with a history of a severe reaction to iodinated contrast. Gadolinium-based CT cystography can be considered a diagnostic alternative when iodinated contrast-based cystography is considered high risk or not feasible. The dilution of GBCA used in our case should provide diagnostic CT cystography to both detect and exclude postoperative leaks.

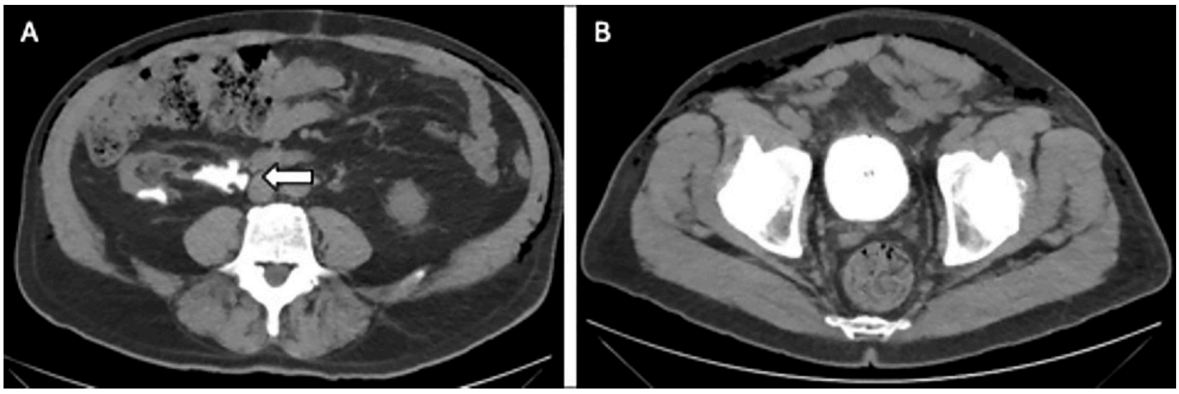

Fig. 2. Axial images post contrast showing intact anastomosis. A) Axial CT after intravesical dilute GBCA administration demonstrates contrast upstream to the anastomosis with no leak (arrow). B) Axial image from a GBCA-based CT cystogram at level of normal appearing bladder.

CRediT authorship contribution statement

Brian Holmes: Conceptualization, Data curation, Investigation, Project administration, Resources, Validation, Writing – original draft, Writing – review & editing. **Sreeja Sanampudi:** Conceptualization, Investigation, Methodology, Resources, Visualization, Writing – original draft, Writing – review & editing. **Lakshmi Ananthakrishnan:** Conceptualization, Data curation, Formal analysis, Investigation, Project administration, Writing – original draft, Writing – review & editing.

References

1. ACR Committee on Drugs and Contrast Media. *ACR Manual on Contrast Media*. American College of Radiology; 2024. Available at: https://www.acr.org/-/media/ACR/Files/Clinical-Resources/Contrast_Media.pdf. Accessed August 6, 2024.
2. Ananthakrishnan L, Parrott DT, Mielke N, Xi Y, Davenport MS. Fidelity of electronic documentation for reactions prompting premedication to iodinated contrast media. *J Am Coll Radiol*. 2021 Jul;18(7):982–989. https://doi.org/10.1016/j.jacr.2021.01.005.
3. Davenport MS, Cohan RH, Caoili EM, Ellis JH. Repeat contrast medium reactions in premedicated patients: frequency and severity. *Radiology*. 2009;253:372–379. https://doi.org/10.1148/radiol.2532090465.
4. Freed KS, Leder RA, Alexander C, DeLong DM, Kliewer MA. Breakthrough adverse reactions to low-osmolar contrast media after steroid premedication. *AJR Am J Roentgenol*. 2001;176:1389–1392. https://doi.org/10.2214/ajr.176.6.1761389.
5. Kang H, Jeong J, Brockow K. Diagnosis and prevention of hypersensitivity reactions to iodinated contrast media. *Allergy Asthma Immunology Research*. 2022;14(4):348–360. https://doi.org/10.4168/aair.2022.14.4.348.
6. Lasser EC. Pretreatment with corticosteroids to prevent reactions to I.V. contrast material: overview and implications. *AJR Am J Roentgenol*. 1988;150:257–259. https://doi.org/10.2214/ajr.150.2.257.
7. O'Malley RB, Cohan RH, Ellis JH, et al. A survey on the use of premedication prior to iodinated and gadolinium-based contrast material administration. *J Am Coll Radiol*. 2011;8:345–354. https://doi.org/10.1016/j.jacr.2010.09.001.
8. Ahn Y, Kang D, Park S, Kim H. Allergic-like hypersensitivity reactions to gadolinium-based contrast agents: an 8-year cohort study of 154539 patients. *Radiology*. 2022;303:329–336. https://doi.org/10.1148/radiol.210545.
9. Do C, DeAguero J, Brearley A, et al. Gadolinium-based contrast agent use, their safety, and practice evolution. *Kidney*. 2020 Jun;1(6):561–568. https://doi.org/10.34067/kid.0000272019.
10. Weinreb J, Rodby R, Yee J, Wang C. Use of intravenous gadolinium-based contrast media in patients with kidney disease: consensus statements from the American college of radiology and the national kidney foundation. *Radiology*. 2021;298:28–35. https://doi.org/10.1148/radiol.2020202903.
11. Newport JP, Dusseault BN, Butler C, Pais Jr VM. Gadolinium-enhanced computed tomography cystogram to diagnose bladder augmentation rupture in patients with iodine sensitivity. *Urology*. 2008;71. https://doi.org/10.1016/j.urology.2007.11.037, 984. e009-984.e011.