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CT Utilization and Pitfalls: Select Clinical Considerations

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Disclosures

- None to disclose

Goals

- Discuss CT utilization in select clinical scenarios
- Discuss CT imaging indications in common clinical presentations
- Discuss CT utilization pitfalls

Case 1

35 M with no significant PMHx presents to the emergency department for evaluation of acute right flank pain radiating into the groin. There is positive FHx for kidney stones.



An axial CT scan of the abdomen, showing the liver, spleen, and kidneys. The text "Imaging Study of Choice?" is overlaid in white. The scan shows a cross-section of the abdominal cavity with various organs and structures visible. The text is centered in the middle of the image.

Imaging Study of Choice?

Non Contrast CT (NCCT)

Diagnosis: Urolithiasis



Acute Flank Pain

- Background
 - Numerous investigations confirm CT to have the highest (>95%) sensitivity and specificity for urolithiasis
 - Virtually all stones are radiopaque on CT
 - Stone location and size are accurately depicted by NCCT

Acute Flank Pain

- Rationale for NCCT
 - The ureter contains several areas where stones commonly become lodged (eg, at the ureteropelvic junction, the iliac vessels, and the ureterovesical junction).
 - The probability of spontaneous passage of a stone is size dependent, and the probability is inversely proportional to stone size.
 - A meta-analysis yielded an estimate that a calculus ≤ 5 mm has a 68% probability of spontaneous passage.
 - A 10-mm stone, however, is very unlikely to pass spontaneously.
 - Therefore, the treating physician wants to know the size of the stone as well as its location.

Acute Flank Pain

- Important Considerations
 - If there is uncertainty about whether a calcific density represents a stone or a phlebolith at NCCT, intravenous contrast material can be given, and excretory phase images obtained for definitive diagnosis.
 - Secondary signs such as ureteral dilatation and perinephric stranding allow CT to make a diagnosis of a recently passed stone.
 - NCCT is also reliable for diagnosing flank pain due to causes other than ureterolithiasis, such as appendicitis and diverticulitis.
 - CT abdomen and pelvis performed with intravenous contrast material is 81% sensitive for detection of all renal stones and >95% sensitive for detection of stones ≥ 3 mm

Acute Flank Pain

- Summary
 - NCCT is the most accurate technique for evaluating flank pain.
 - Low-dose NCCT should be performed when evaluating for renal or ureteral stones.
 - Stone vs phlebolith, can repeat CT with IV contrast
 - In pregnant patients with flank pain, US is the best initial study.
 - Abdominal radiography combined with US may be able to diagnose most clinically significant stones and should be considered, especially in young patients and those with known stone disease.
 - MRI could be considered to evaluate for hydronephrosis though is less accurate for the direct visualization of renal and ureteral stones.

Case 2

42 F with PMHx of dysmenorrhea and migraine headaches presents to the ED with chief complaint of progressively worsening right sided headache for the past 4 days. Her headache began after she had been staring at her laptop during a virtual medical educational conference. She describes the headache as throbbing and is associated with light sensitivity and nausea. She denies fever and there is no neck stiffness on physical examination. She is very familiar to all her current symptoms.



An axial CT scan of a human head, showing the brain and surrounding structures in grayscale. The image is centered and occupies most of the frame. The text "Imaging Study of Choice?" is overlaid in white, sans-serif font in the center of the brain area.

Imaging Study of Choice?

CT imaging not indicated

Diagnosis: Migraine Headache



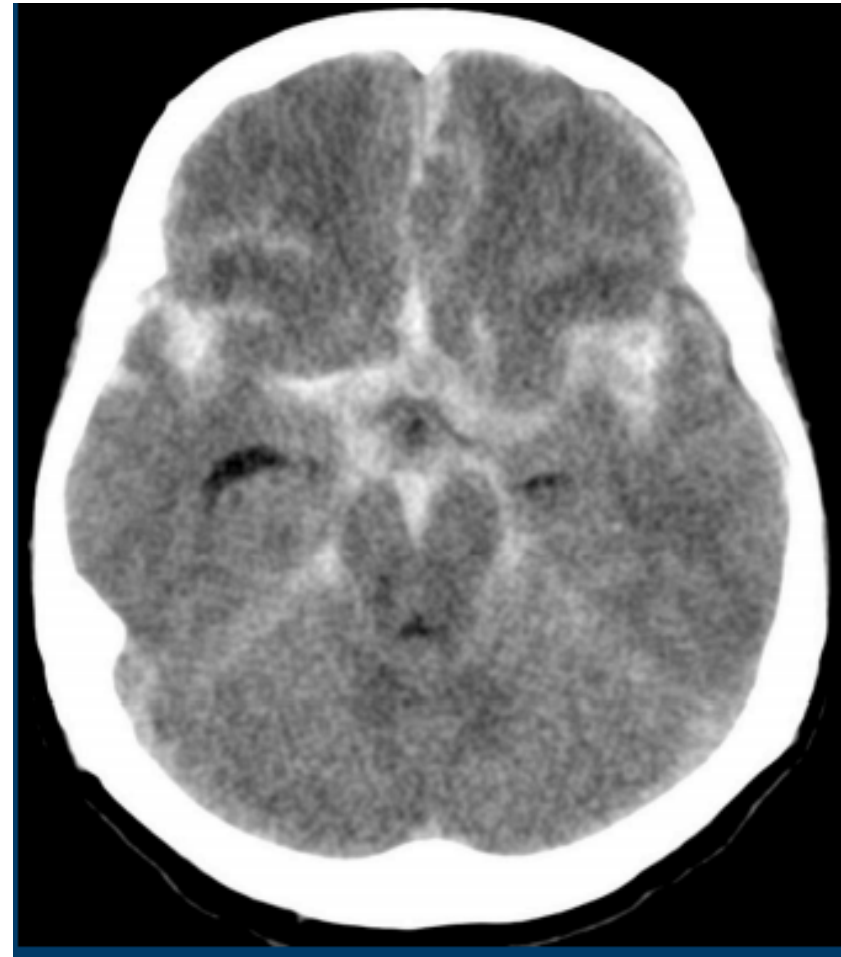
Headache Clinical Variants

- Variant 1: Sudden, severe headache or “worst headache of life”
- Variant 2: New headache with optic disc edema
- Variant 3: New or progressively worsening headache **PLUS RED FLAG**: subacute head trauma, related activity or event (sexual activity, exertion, position), neurological deficit, known or suspected cancer, immunosuppressed or immunocompromised state, currently pregnant, or 50 years of age or older
- Variant 4: New headache. Classic migraine or tension-type primary headache Normal neurologic examination
- Variant 5: New primary headache of suspected trigeminal autonomic origin
- Variant 6: Chronic headache. No new features. No neurologic deficit
- Variant 7: Chronic headache. New features or increasing frequency

Variant 1: Sudden,
severe headache or
“worst headache of life.”

Initial imaging: CT head without IV contrast
(NCCT)

Diagnostic endpoint: SAH



Variant 2: New headache with optic disc edema

Initial imaging:

CT head without IV contrast

MRI head without IV contrast

MRI head with and without IV contrast

Diagnostic Endpoint: Space occupying lesion-abscess, tumors, hematoma, cerebral edema, hydrocephalus, medications, and primary idiopathic intracranial hypertension or cerebral venous thrombosis



Variant 3: New or progressively worsening headache **PLUS RED FLAG**

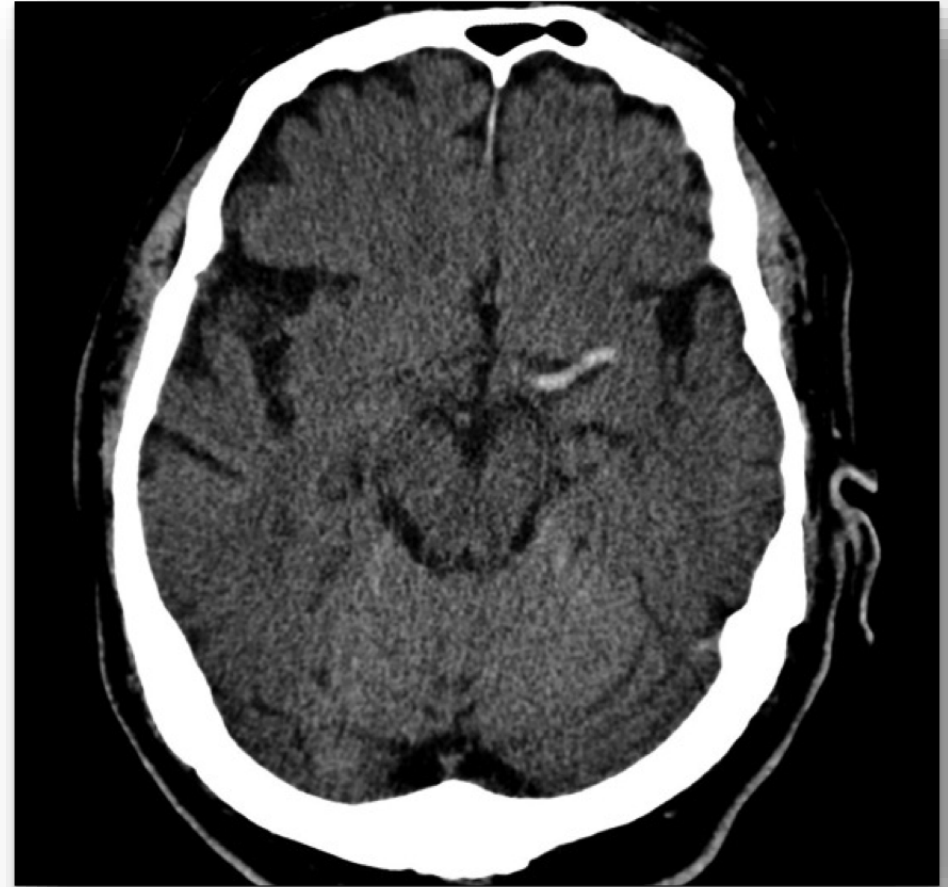
Initial imaging:

CT head without IV contrast

MRI head with and without IV contrast

MRI head without IV contrast

Diagnostic Endpoint: **FOLLOW THE RED FLAG, especially neurological deficit**



Variant 4: New headache. Classic migraine or tension-type primary headache. Normal neurologic examination

Initial imaging:

USUALLY NOT APPROPRIATE

Diagnostic Endpoint: "Peace of mind"



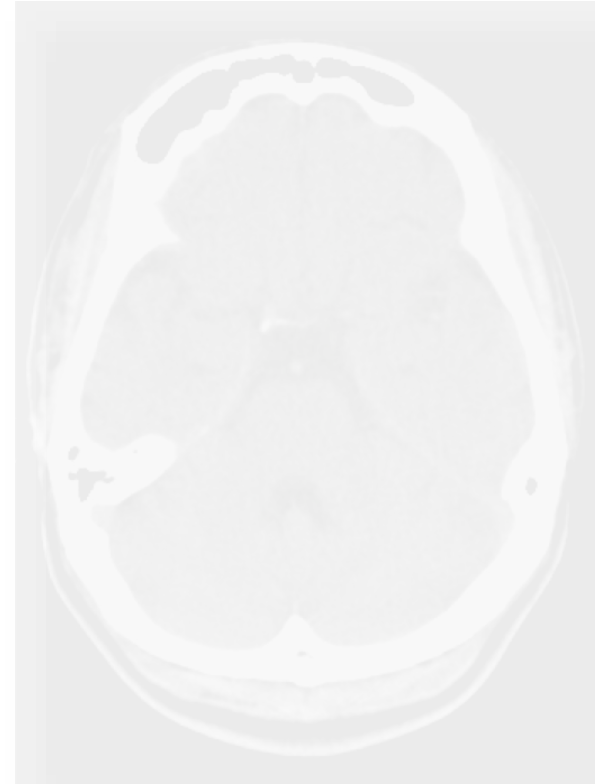
Variant 5: New primary
headache of suspected
trigeminal autonomic origin

Initial imaging:

MRI head with and without IV contrast

MRI head without IV contrast

Diagnostic Endpoint: Tumor



CT image of trigeminal nerve

Variant 6: Chronic
headache. No new features.
No neurologic deficit

Initial imaging:

USUALLY NOT APPROPRIATE

Diagnostic Endpoint: "Peace of mind"



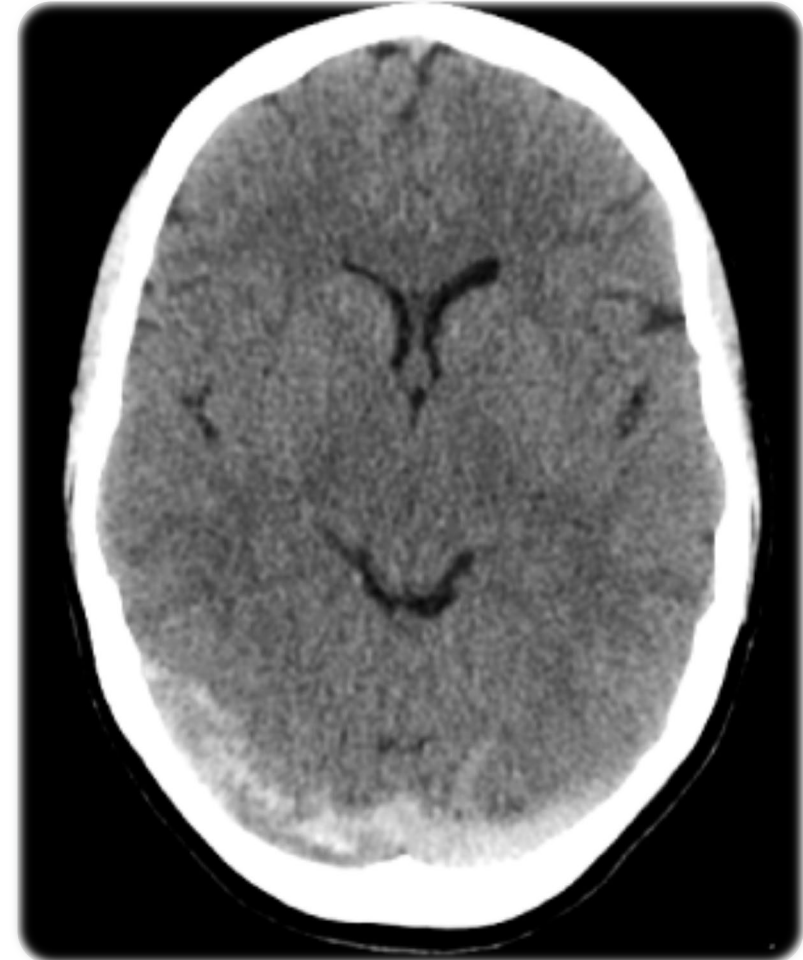
Variant 7: Chronic
headache. New features
or increasing frequency

Initial imaging:

MRI head with and without IV contrast

MRI head without IV contrast

Diagnostic Endpoint: **RED FLAG ETIOLOGY**



Case 3

- 38 M with PMHx of pulmonary embolism presents to the ED with acute abdominal pain, nonbloody/nonbilious vomiting, and bloody stools for 1 day. Patient takes no medications, has no known FHx, has never been a smoker, and he drinks socially. On physical examination he appears ill, he appears to have severe diffuse abdominal tenderness, but he does not guard to palpation. The cardiac monitor shows a rapid rate but normal rhythm.

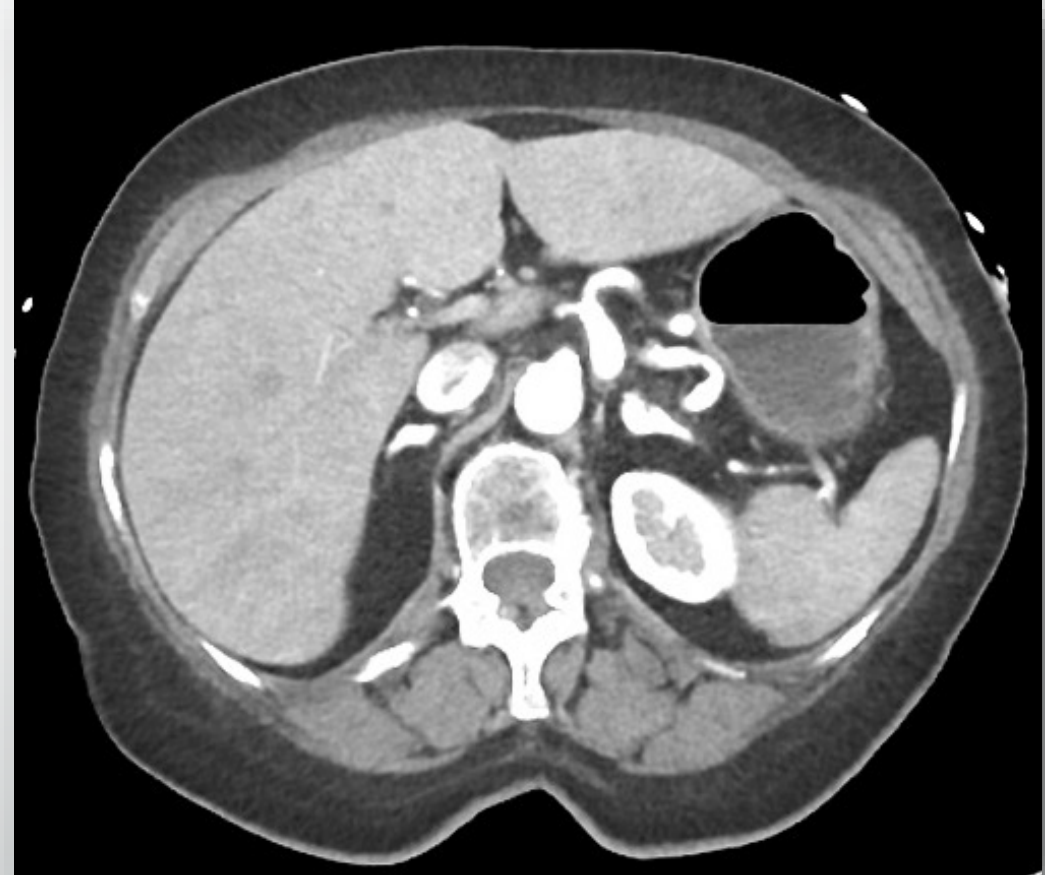


An axial CT scan of the abdomen. The image shows the liver on the left, the spleen on the right, and the kidneys in the center. A large black rectangular area obscures the upper right portion of the scan, likely representing a lesion or a specific area of interest. The text "Imaging Study of Choice?" is overlaid in white in the center of the image.

Imaging Study of Choice?

CT Angiogram Abdomen/Pelvis
(CTA-AP)

Diagnosis: Mesenteric Ischemia



Suspected Mesenteric Ischemia

- Background
 - Mesenteric ischemia is an uncommon disease affecting the small and large bowel resulting from a reduction of intestinal blood flow
 - The etiology of ischemia may vary from arterial occlusion, venous thrombosis, or vasoconstriction.
 - Higher prevalence in the elderly population and nonspecific clinical presentation leading to delayed diagnosis contribute to the high mortality rate.
 - Most cases of mesenteric ischemia are due to an acute event leading to decreased blood supply to the splanchnic vasculature.

Suspected Mesenteric Ischemia

- Rationale for CTA-AP
 - All elements are essential:
 - 1) timing
 - 2) reconstructions/reformats
 - 3) 3-D renderings
 - Standard CTs with IV contrast also include timing issues and recons/reformats.
 - Only in CTA, however, is 3-D rendering a required element.

Suspected Mesenteric Ischemia

- Important Points
 - Differentiate from other more common causes of acute abdominal pain
 - Early in the course of disease, laboratory findings are of little value
 - Unfortunately, the signs, symptoms, and laboratory testing are insufficient for making the diagnosis

Case 3

• 17 F with PMHx of asthma presents to a small community hospital emergency department with chief complaint of right lower quadrant pain, nausea, fever 101.2, and anorexia for 1 day. The pain began around the umbilicus and has migrated to the right lower abdomen. The patient is not sexually active and denies urinary symptoms. Physical examination is positive for right lower abdominal tenderness at a point between the umbilicus and the anterior superior iliac spine. Blood work reveals a leukocytosis. Formal ultrasound is nondiagnostic. BMI is 24.

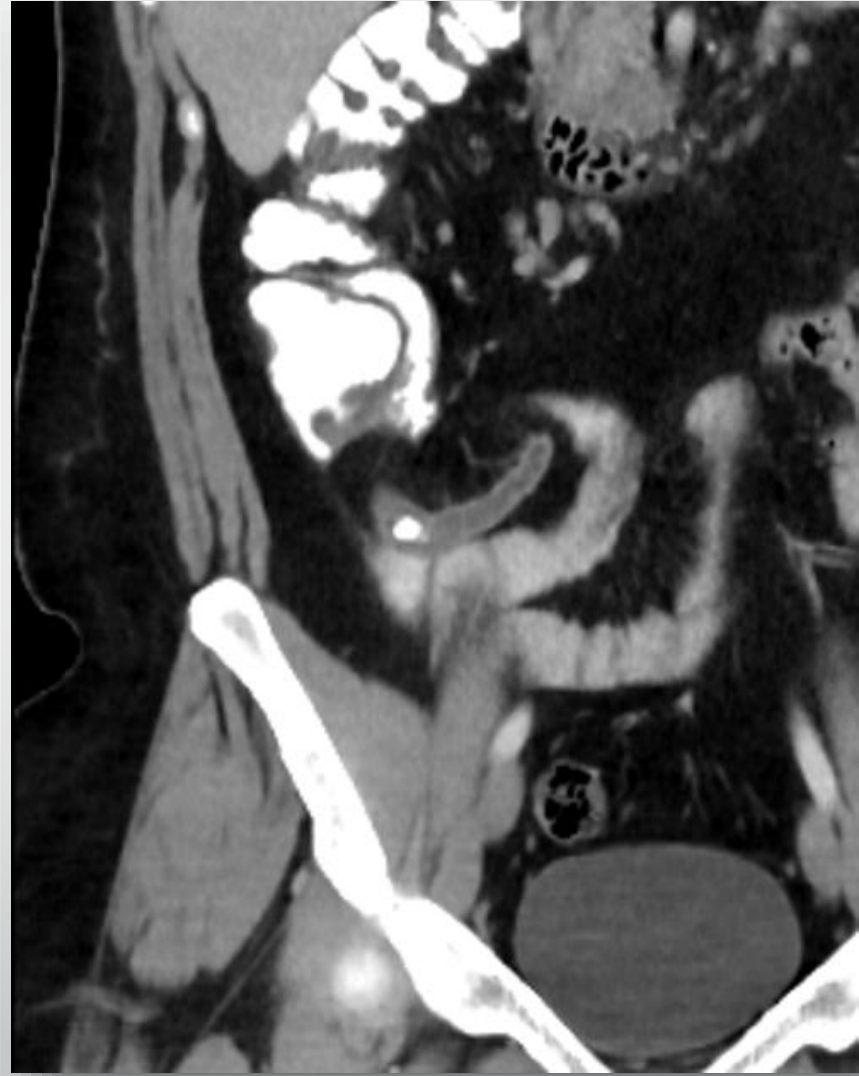




Imaging Study of Choice?

CT Abdomen/Pelvis
with IV contrast and oral contrast

Diagnosis: Acute Appendicitis



Right Lower Quadrant Pain: Suspected Appendicitis

- Background
 - “Classic” presentation: periumbilical abdominal pain migrating to the RLQ, loss of appetite, nausea or vomiting, with fever, and leukocytosis
 - Only present in 50% of patients
 - Atypical presentations and alternative diagnosis

Right Lower Quadrant Pain: Suspected Appendicitis

- Rationale for CT-AP
 - CT has become the primary diagnostic imaging modality for the evaluation of patients with suspected appendicitis because of its high diagnostic yield.

Right Lower Quadrant Pain: Suspected Appendicitis

- Important Points

- Typical presentation: In patients with RLO pain with fever and leukocytosis, CT abdomen and pelvis with IV contrast is usually appropriate to evaluate for suspected appendicitis.
- Atypical presentation: In patients with RLO pain with fever and leukocytosis in an atypical presentation, CT abdomen and pelvis with IV contrast is usually appropriate to evaluate for possible appendicitis.
- Pregnancy: MRI abdomen and pelvis without IV contrast or US abdomen is the primary modality for interrogation of the pregnant patient with suspected appendicitis.
- *Pediatric
- *Oral contrast

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