Imaging techniques to diagnose suspected kidney stones

A randomised controlled trial in the US found that using ultrasonography as initial imaging for suspected kidney stones in people presenting to A&E was associated with less radiation exposure than CT and did not increase the incidence of subsequent high-risk diagnoses with complications that could be related to missed or delayed diagnosis.

Overview: Kidney stones (nephrolithiasis) occur when calcium or other minerals in the urine crystallise into a hard compact mass in the kidney (NHS Choices 2014). These stones can pass out of the kidney and become lodged in the ureter or other parts of the urinary tract (urolithiasis). Stones in either the kidney or the ureter can cause abdominal or flank pain (renal colic) and other symptoms such as blood in the urine (haematuria) and nausea.

People with symptoms of kidney stones may be referred for imaging to confirm the diagnosis or to identify where a kidney stone is. Non-contrast CT can accurately identify stones in the kidney (Kim et al. 2005), but entails exposure to ionising radiation and the attendant long-term cancer risk (Smith-Bindman et al. 2009). Another option is ultrasonography, which is cheaper than CT and does not involve radiation. However, ultrasonography may not be as accurate as CT (Ray et al. 2010).

Current advice: The European Association of Urology guidelines on urolithiasis recommend that the clinical diagnosis of acute renal or ureteric colic should be supported by appropriate imaging. Ultrasonography should be used as the primary diagnostic imaging tool for patients with urinary stones. Non-contrast CT should be used to confirm stone diagnosis in patients with acute flank pain.

Guidelines for the acute management of first presentation of renal/ureteric lithiasis from the British Association of Urological Surgeons likewise recommend non-contrast CT within 24 hours if presentation is acute and to confirm diagnosis of kidney stones.

New evidence: Smith-Bindman et al. (2014) performed a randomised controlled trial of ultrasound compared with CT as initial imaging for suspected kidney stones. The study recruited people with flank or abdominal pain who presented to the emergency room at one of 15 hospitals in the USA. Cases where imaging was ordered to diagnose kidney stones were randomly assigned to ultrasonography performed by the doctor (point-of-care ultrasonography), ultrasonography performed by a radiologist, or abdominal CT. The primary outcomes were the subsequent incidence of high-risk
diagnoses with complications, such as pneumonia with sepsis and renal infarction, that could be related to missed or delayed diagnoses, and cumulative radiation exposure from imaging.

A total of 2759 patients were randomly assigned to point-of-care ultrasonography (n=908), radiology ultrasonography (n=893), and CT (n=958). The incidence of high-risk diagnoses with complications within 30 days after the emergency department visit was similar in the 3 study groups. Overall, 6 patients (0.7%) assigned to point-of-care ultrasonography, 3 (0.3%) assigned to radiology ultrasonography, and 2 (0.2%) assigned to CT had high-risk diagnoses (p=0.30). People who underwent point-of-care ultrasonography or radiology ultrasonography were exposed to considerably less radiation over the 6 months from randomisation than those assigned to CT (10.1 mSv and 9.3 mSv, respectively, versus 17.2 mSv; p<0.001).

When the diagnosis at initial imaging was compared with confirmed stone diagnosis at 30-day follow-up (n=2382), the 3 techniques had similarly high sensitivity (point-of-care ultrasonography=85%, radiology ultrasonography=84%, CT=86%; p=0.74). Specificity for the 3 imaging modalities was lower (point-of-care ultrasonography=50%, radiology ultrasonography=53%, CT=53%; p=0.38).

A considerable proportion of patients in the ultrasonography groups (40.7% in the point-of-care group and 27.0% in the radiology group) underwent CT during the initial visit to the emergency department. The authors caution that their results do not suggest that patients should undergo only ultrasound imaging, but rather that ultrasonography could be used as the initial diagnostic imaging test, with further imaging studies performed at the discretion of the doctor. Other limitations of this study include that investigators, patients and physicians could not be blinded to the study group assignment.

Commentary: “This US trial evaluates a pragmatic alternative to across-the-board CT – that is, ultrasonography with selective CT – rather than directly comparing ultrasonography with CT. This approach makes the findings highly applicable to the trial setting but more difficult to generalise elsewhere. Diagnostic imaging is used more sparingly in the UK than the US, so it is not clear what the relevant pragmatic comparison would be in the UK.

“The distinction between US and UK practice is also relevant when considering the study population. Patients with a high probability of nephrolithiasis were selected, and people were excluded if there was a high risk of alternative serious pathology. Typical UK practice often involves selective use of imaging to concurrently rule out a serious alternative diagnosis as well as evaluate kidney stones. Patients with a clear diagnosis of renal or ureteric colic and low risk of alternative pathology may not receive imaging in A&E.

“Another factor, considered by the authors, is the need for appropriately trained staff to undertake imaging. Ultrasound in emergency settings is developing in the UK, but few emergency medicine doctors are currently able to maintain the skills required to accurately diagnose kidney stones.

“These points may limit the potential for this impressive study to guide practise in the UK. However, the comparison of diagnostic accuracy reported here could prompt an increase in the use of ultrasound as a first-line test. Previous studies suggest that CT is more sensitive than ultrasound. This study found that both techniques have good sensitivity but limited specificity. This finding probably reflects the use of a pragmatic reference standard (confirmation by the patient of the stone passing or by surgery) that will miss small stones that pass unnoticed. The higher sensitivity for CT reported in previous studies could potentially reflect detection of insignificant stones. If so, it is possible that ultrasound detects the pathology that matters without the radiation-related risks of CT.” – Professor Steve Goodacre, Professor of Emergency Medicine, University of Sheffield

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