

# National Imaging Trends after Ureteroscopic or Shock Wave Lithotripsy for Nephrolithiasis



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## Abbreviations and Acronyms

AUA = American Urological Association  
CT = computerized tomography  
HMO = health maintenance organization  
IVP = excretory urogram  
KUB = plain abdominal x-ray  
MSA = metropolitan statistical area  
RUS = renal ultrasound  
SWL = shock wave lithotripsy  
URS = ureteroscopy with stone extraction or laser lithotripsy

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**Editor's Note:** This article is the third of 5 published in this issue for which category 1 CME credits can be earned. Instructions for obtaining credits are given with the questions on pages 578 and 579.

**Purpose:** The study of diagnostic imaging after procedural intervention for nephrolithiasis is limited. We sought to characterize actual national imaging patterns and longitudinal trends after ureteroscopic or shock wave lithotripsy.

**Materials and Methods:** We analyzed the MarketScan® database and identified a nationally representative sample of insured, employed patients, 17 to 64 years old who underwent ureteroscopic or shock wave lithotripsy for nephrolithiasis between 2007 and 2014. Patients were excluded from study if they lacked at least 1 year of postoperative database enrollment or underwent a repeat nephrolithiasis procedure of any type within 90 days after the initial procedure. We identified and tracked postoperative imaging modalities by medical billing codes.

**Results:** We identified 101,554 patients treated with ureteroscopy, of whom 55% and 39% underwent no postoperative imaging within 3 and 12 months, respectively. Of the 101,590 patients treated with shock wave lithotripsy 23% and 16% underwent no postoperative imaging within 3 and 12 months, respectively. Abdominal x-ray was the most common imaging modality after either procedure type. Ultrasound use increased with time while computerized tomography decreased. In about 25% of ureteroscopy and shock wave lithotripsy cases at least 1 postoperative computerized tomography was done within a year. Female gender and older age were associated with higher imaging rates. Ultrasound was more commonly performed in the northeast region and in more densely populated areas.

**Conclusions:** A notable portion of patients treated with ureteroscopy and a smaller percent treated with shock wave lithotripsy do not undergo any followup imaging within 1 year. In the majority who undergo imaging abdominal x-ray is done, precluding the ability to screen for hydronephrosis or silent obstruction in almost 75% of patients treated with ureteroscopy.

**Key Words:** kidney calculi; lithotripsy; ureteroscopy; ultrasonography; tomography, x-ray computed

KIDNEY stones will develop in approximately 1 of 11 Americans in a lifetime,<sup>1</sup> of whom about a quarter will require procedural intervention.<sup>2</sup> URS and SWL are the 2 most common techniques for surgical treatment of nephrolithiasis. Followup imaging may be used to assess for stone and fragment clearance,

resolution of hydronephrosis and development of complications, particularly occult obstruction.

The appropriateness of routine followup imaging remains a poignant topic of debate, especially after URS. While some urologists argue for routine imaging,<sup>3</sup> others contend that selective imaging based on clinical

concern and risk factors for stricture formation or residual stone burden is reasonable.<sup>4–7</sup> Those opposed to routine imaging cite concerns regarding cost, over use of resources and the relatively low incidence of ureteral stricture.

In 2012 the AUA published a clinical guidance document acknowledging that “imaging all ureteroscopy patients... is not cost effective” but “the relatively low cost and lack of ionizing radiation associated with renal sonography justifies its use in routine followup of patients treated for ureteral calculi.”<sup>8</sup> The same document outlines recommended clinical algorithms which all include routine imaging after SWL or URS. To address routine monitoring in stone forming patients the 2014 AUA guideline panel on medical management of nephrolithiasis recommends that clinicians “periodically obtain followup imaging studies.”<sup>9</sup>

To our knowledge no studies to date have captured national imaging patterns after URS and SWL. We describe actual imaging selection and timing patterns as well as longitudinal trends after SWL or URS in a nationally representative cohort.

## METHODS

We analyzed the MarketScan® database, which captures health care claims data from primarily large employer sponsored health plans, to track medical care in a nationally representative sample of insured, employed patients. It is estimated that almost half of the population in the United States receives health coverage through employers. The database tracks more than 50 million individuals annually and can include beneficiary spouses and dependents. By tracking paid insurance claims complete episodes of medical care can be tracked longitudinally across various inpatient and outpatient settings. The database has been used in many national health care studies.<sup>10</sup> The 2007 to 2015 data are accessible to our group through a university sponsored research contract.

Adult patients who underwent URS or SWL between 2007 and 2014 were identified using CPT and ICD-9 procedure codes (see Appendix). Study exclusion criteria included age 65 years or greater, less than 1 year of health care plan enrollment after the procedure and 6 months before the procedure or a repeat stone procedure of any type, including percutaneous nephrolithotomy, within 90 days after initial URS or SWL. These criteria eliminated ambiguity with patients enrolled in Medicare, ensured long-term health care plan continuity and excluded those with more complex stone disease requiring staged procedures.

Cumulative postoperative imaging studies were assessed at 3, 6 and 12 months, including CT, KUB, RUS and IVP. We also examined combination imaging rates as well as repeat imaging rates in patients imaged within the first 3 months. Combination imaging was defined as more than 1 type of imaging modality within a specified interval. Patients with more than 1 imaging study of the same type in an interval were counted once.

We extracted patient demographic data to look for associations with imaging patterns, including age, gender, regional location, HMO enrollment and location in a MSA. A MSA reflects a geographic area meeting certain population density numbers and economic ties to the region and it does not necessarily reflect a major city or single county.<sup>11</sup> To examine longitudinal trends we plotted the percent of patients in whom each imaging type was done with time in years. Use patterns by demographic factors were assessed by the chi-square test and logistic regression models using SAS®, version 9.4.

## RESULTS

We identified 142,425 URS and 148,711 SWL eligible MarketScan enrollees. Excluded from study were 29% and 32% of URS and SWL cases, respectively, with repeat procedures of any type within 90 days after the initial procedure. The final study cohort included 101,554 URS and 101,590 SWL cases.

Demographic factors in the 2 treatment groups were equally distributed and reflected the higher nephrolithiasis incidence in middle-aged and male patients as well as in the South region (table 1). Most patients in the 2 procedure groups resided in a MSA but did not belong to a HMO.

Of the patients 55% in the URS group did not undergo any imaging within the first 3 months. By 12 months 40% of the patients still had not been imaged. In decreasing order the most common imaging types were KUB, RUS, CT and IVP (fig. 1). Combination imaging was done by 3 months in 11% of URS cases. The most common combinations were RUS and KUB in 40% of patients followed by CT and KUB in 34% (fig. 2). Of the patients imaged

**Table 1. Patient demographics**

	No. URS (%)	No. SWL (%)
Overall	101,554 (100)	101,590 (100)
Age:		
17–39	26,890 (26)	23,991 (24)
40–49	26,089 (26)	26,301 (26)
50–59	33,855 (33)	35,580 (35)
60–64	14,720 (14)	15,718 (15)
Male	55,930 (55)	57,197 (56)
Female	45,624 (45)	44,393 (44)
Region:		
Northeast	15,004 (15)	16,547 (16)
North Central	26,757 (26)	24,329 (24)
South	44,005 (43)	45,024 (44)
West	13,440 (13)	13,519 (13)
Unknown	2,348 (2)	2,171 (2)
HMO:		
Yes	12,154 (12)	12,366 (12)
No	89,400 (88)	89,224 (88)
MSA:		
Yes	80,519 (79)	81,460 (80)
No	18,709 (18)	18,033 (18)
Unknown	2,326 (2)	2,097 (2)

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