1. Introduction

One in 11 people in the United States are affected

by urolithiasis and disease prevalence is on

the rise.1 The American Urological Association

(AUA) Guidelines provide specific size thresholds to help

guide appropriate surgical options for kidney stones.2,3 As

a result, surgical decision-making for nephrolithiasis relies

on an accurate assessment of stone burden. Although urologists

are trained and board examined to independently

review radiologic studies for patient care,4 how this interpretation

compares with official radiologic reports remains

unknown.

In addition, while health care legislation is still evolving,

quality is a major component of the Affordable Care

Act and the Medicare Access and CHIP Reauthorization

Act (MACRA) of 2015.5,6 For urinary stone disease, an

accurate estimation of a patient’s stone burden represents

an essential starting point for any discussion on the quality

of care provided.7 At present, there is no standardized reporting

methodology used by practicing radiologists and

urologists to ensure that imaging reports and preoperative

documentation accurately reflect total stone number,

volume, location, and potential case complexity.

Ideally, a consensus could be reached between the urologic

and radiologic communities as to how stone burden

can be quantified in an accurate and reproducible manner.

To these ends, the aim of this study was to utilize a highquality,

prospective kidney stone registry to investigate the

concordance in stone burden estimation by urologists compared

with radiologists.

Nouns:

The American Urological Association (AUA) Guidelines

Index patients

Characteristics

Aggregate stone size, as measured by CT

Concordance

Surgical Decision making

Accurate assessment

Interpretation

Evidence

Purpose of this study is two-fold: first,

Verbs:

Investigate, analyze, compare, control for other factors that influence

However, not a lot of detail. No reference to stone multiplicity.

* 1. Purpose of study:
     1. Look at the factors associated with differences in estimation of the size of the stones
     2. Look at the factors associated with treating a patient with URS when over 20mm.

We will continue the work of David Tzou et al. and address two questions regarding the effect of multiple stones on

**Methods**

*Study Participants*

From October 2015 through November 2018, consenting patients treated for urinary stone disease at the University of California, San Francisco (UCSF) Urology Department were prospectively enrolled into the Registry for Stones of the Kidney and Ureter (ReSKU), the methodology of which has been previously described. The ReSKU study has been approved by the Committee on Human Research (Protocol 14-14533).

*Inclusion Criteria*

ReSKU patients were included only if they presented symptomatically, received either a computed tomography (CT) scan or ultrasound (US) at UCSF during their first admission, and underwent either ureteroscopy (URS) or percutaneous nephrolithotomy (PCNL) for a first operation.

*Exclusion Criteria*

Pediatric patients and patients who were pregnant during their intake visit were excluded from this study. Patients with a known bleeding disorder or patients on anticoagulation were also excluded.

* 1. Inclusion Criteria

Consenting adult

* + 1. Surgically managed with either URS or PCNL or some combination of the two.
    2. Had imaging at UCSF, either CT or ultrasound or both, during which time the location, aggregate burden, and number were present and prospectively recorded onto ReSKU by the primary surgeon.
    3. Presented symptomatically.
  1. Exclusion Criteria (Patients were excluded who either bleeding disorder).
     1. Patients with documented bleeding disorders.
     2. Patients on oral anticoagulation
     3. Pregnant during the time of the operation.
     4. Patients with missing data were excluded from the study.
  2. Data Collected
     1. Patient characteristics
        1. Gender, BMI, presentation, information regarding prior treatments,
     2. Radiological reports:
        1. The following stone characteristics were recorded: stone number, laterality, location, aggregate burden (assessed in mm) were gathered.
     3. Surgical reports:
        1. Aggregate burden, operation type, and treating surgeon.
  3. Comparing Radiologic Interpretation and Intraoperative Assessment of Stone Burden
  4. Statistical Analyses.
     1. Statistical analyses and figures were completed using R software (version 3.4.0, The R Foundation for Statistical Computing).
     2. Demographic, Radiological, and Surgical characteristics were aggregated using XXX and YYY when appropriate.
     3. Logistic regression was performed to determine which of these characteristics was associated with discrepancies between burden as assessed by imaging versus that assessed by the surgeon intraoperatively.
     4. From these patients, those with renal stones > 20mm by imaging

**Results**

*Subjects Demographics and Data Quality*

1194 subjects were enrolled in ReSKU between October 2015 and November 2018, of which 309 met inclusion criteria for the primary analysis. From these patients, 351 renal units were available for the primary analysis. Patient and renal unit features can be found in Table 1. No data were missing with the exception of body mass index (BMI); 4 (1.3%) patients were missing BMI records.

*Primary Analysis*

Of the 351 renal units available in the primary analysis, surgeons overestimated the aggregate burden in 61 cases (18%), underestimated the burden in 31 cases (9%), and provided estimates concordant with imaging in 254 cases (72%, Figure 1). Multiple stones were present in 81% of operations during which the surgeon underestimated stone burden, whereas multiple stones were present in only 46% of cases during which the surgeon’s estimate was concordant with imaging (Chi-squared = 28.102, p < 0.001). Overestimations were less frequently associated with multiple stones (28%, Chi-squared = 28.102, p < 0.001).

Logistic regression was performed to examine this association between the number of stones and aggregate burden underestimation (Table 2). After controlling for demographics, imaging type, operation type, and operating surgeon, each additional stone increased the odds of underestimating aggregate burden. Two stones increased the odds by a factor of 5 (4.7, 95% CI: 1.56 – 15.25), while three stones increased the odds of underestimating the burden 10-fold (9.68, 95% CI: 2.37 – 39.36). Patients with more than three stones had the highest increase in odds (10.19, 95% CI: 3.32 – 34.82).

Sensitivity analyses were conducted to further examine the association between stone number and the odds of underestimating stone burden. The effect of multiple stones on the odds of underestimation remained statistically significant after removing patients with ureteral stones from the analysis, after removing PCNL patients from the analysis, and after removing patients with an over-weighted influence on the regression model (Appendix A).

*Secondary Analysis*

109 of the 309 patients in the primary analysis had large (>20mm) renal stones on imaging and were included in a secondary analysis (Table 1). Logistic regression was performed to determine the association between patient features and the choice of URS as a first line therapy (Table 3). Patients with three stones had seven times the odds of undergoing URS as a first line therapy, despite possessing large renal stones (AOR 7.00, 95% CI 1.19 – 47.86). Patients with more than three stones had 26 times the odds of undergoing URS (AOR 26.44, 95% CI 5.42 – 183.09). Each centimeter above 2cm was associated with a reduction in the odds of URS by 72% (AOR 0.28, 95% CI 0.13 – 0.51). Increasing age and the presence of anatomic anomaly increased the odds of undergoing URS.

Sensitivity analyses were conducted to further examine the relationship between stone number and choosing URS as a first-line therapy. Having three or more stones (“3” and “>3”) remained significantly associated with undergoing URS after adding two additional patient features - ASA score and history of prior surgery - to the model, and remained significant after removing patients with an over-weighted influence on the regression model (Appendix B). Having greater than three stones (“>3”) remained significantly associated with choice of surgery after restricting the analysis to patients with more than 25mm aggregate burden, but having three stones fell out of statistical significance significance.

1. Discussion
   1. Provided two pieces of evidence that the presence of multiple stones interferes with the execution of AUA guidelines.
      1. Makes estimating the total burden difficult.
      2. Is associated with deviations from practice guidelines already. URS becomes more likely as soon as three or more stones are present, particularly for patients with aggregate burdens that are just above 20mm.
   2. These results are robust – stone number remained a significant influence on the ability to estimate stones