Care of acute renal colic: a survey of emergency medicine physicians

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Introduction: *To determine the contemporary practice patterns of academic emergency department (ED) providers in the United States for an episode of acute renal colic.*

Materials and methods: *A 30-question survey was developed to assess ED providers' clinical decision making for an index patient with acute renal colic. The survey population was all attending and resident physicians affiliated with an American emergency medicine residency program with an institutional profile available on the Society for Academic Emergency Medicine (156 programs; 95% of programs in the United States). The survey was conducted in October 2014. A response rate of 8.1% (289/3563) was achieved, which represented 29% (46/156) of the programs.*

Results: *Only 17% (53/289) of respondents were aware of the American Urological Association (AUA) guidelines on the management and imaging of ureteral calculi. A clinical care pathway was uncommon amongst institutions (6/46; 13%), but desired by providers (193/289; 67%). A low dose non-contrast computed tomography (CT) would be the most preferred initial diagnostic imaging modality (139/289; 48%). Initial imaging choice was not influenced by respondent role, program, census region, practice environment, ED size, ED volume, presence of a clinical care pathway, or knowledge of the AUA guidelines (all $p > 0.05$).*

Conclusions: *In this cross-sectional survey of academic emergency medicine providers, we demonstrated a lack of awareness of quality initiatives and uncommon use of clinical care pathways. We observed that diagnostic imaging modalities with reduced radiation were commonly preferred, and that imaging preference was not associated with several demographic or institutional characteristics.*

Key Words: emergency care, health care surveys, nephrolithiasis, physician's practice patterns, renal colic

Introduction

Nephrolithiasis is common within the United States with an estimated overall lifetime prevalence of 9%.[1] As such, it is a disease commonly encountered in routine clinical practice, particularly in the emergency department (ED). Patients often present for an acute care visit after the development of episodic flank pain associated with an obstructing calculus. Therefore, ED providers are commonly charged with the initial diagnosis and management of acute renal colic. In fact, an analysis of a nationally representative sample of all United States ED visits from 2006-2009 demonstrated a rate of approximately 1.2 million patients per year or 1% of all ED visits per year.[2] Furthermore, ED visits increased 15% alone over the 4 year study period.[2]

Our understanding of the care of these patients in the ED is largely through analyses of administrative databases.[2-7] Although this information is useful for identifying certain trends, there are limitations. Specifically, previous analyses have not examined the awareness of evidence based guidelines,[8,9] the use of new diagnostic imaging protocols and modalities with reduced radiation,[10-13] and the indications for urological consultation.

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Therefore, we performed a cross-sectional survey of all academic affiliated emergency medicine providers in the United States to assess their current practice patterns for an episode of acute renal colic. We hypothesized that quality initiatives designed to provide evidence based care would be limited, adoption of diagnostic imaging with reduced radiation exposure would be commonplace, and utilization of urological consultation would be variable.

Materials and methods

Survey instrument

A survey was created to assess ED providers' practice for treating a patient with acute renal colic. The questionnaire assessed institutional characteristics, such as Census Division location, ED size and volume with answer choices determined by a review of national ED data,[14] the presence of quality initiatives, and diagnostic imaging resources. It also assessed ED providers' demographics, clinical decision making, and the use of urological consultation. The questionnaire took approximately 5 minutes to complete and consisted of a maximum of 30 questions. The survey was pre-tested by administering it to a focus group of ED providers to ensure that the questions comprehensively and accurately characterized potential clinical decision making for ED providers in the care of patients with acute renal colic. We revised the questionnaire based on the feedback received.

Study population

The eligible population included all ED providers affiliated with an allopathic emergency medicine residency program within the United States who had a residency program profile available on the Society for Academic Emergency Medicine (SAEM) website (http://beta.saem.org/membership/services/residency-directory). From the SAEM profile (accessed September 2014), residency program characteristics (total number of ED beds, annual number of ED patients treated per year, number of ED residents per year, number of ED faculty, and ED residency program length) were extracted. A total of 156 programs with complete contact information and program characteristics were available. This represented 95% (156/164) of accredited emergency medicine residency programs in 2013-2014.[15]

The electronic survey was distributed via email (sent October 2014) to all 156 residency program coordinators and directors with a request to forward it to all practicing providers. A reminder to complete the survey was sent at 1 week and 2 weeks following the initial invitation. Only responses from attending or resident physicians were included in the analysis (excluded a total of 19 fellow physicians and advanced practice providers), and were grouped together as we could not reliably know how attending supervision influenced resident clinical decision making. Survey data was developed, collected, and managed using REDCap hosted at the University of Pennsylvania. REDCap is a secure, web-based application designed to support data capture for research studies.[16]

Statistical analysis

Data was reported at the institutional level (n = 46) when the variable assessed resources potentially available to all respondents from that institution (e.g. availability of ultrasound). If there was a discrepancy between respondents from the same institution, then we classified the outcome as defined by the majority. When the variable assessed clinical decision making for that individual respondent (e.g. preferred imaging choice) then the data was reported at the respondent level (n = 289).

A chi-square test was performed to assess the influence of demographic and institutional characteristics on respondents' knowledge of guidelines, desire for a clinical care pathway, preference for initial diagnostic imaging choice, and use of consultation. Tests were 2-sided, and the threshold of statistical significance was defined at $p < 0.05$. Statistical analysis was performed using IBM SPSS Statistics for Windows (Version 20.0. Armonk, NY, USA). This study was approved by the institutional review board of the University of Pennsylvania, and informed consent was waived.

Results

At least one contact (returned, completed survey) was obtained from 29% (46/156) of the available residency programs. Characteristics of these 46 institutions are displayed in Table 1. Assuming that the survey was distributed to all providers at each of the 46 institutions we used a formula based on known program composition ((number of residency positions per entering class x total program length) + total number of faculty)) to calculate the total eligible population, which was 3563 providers. A total of 289 returned a completed survey for a response rate of 8.1% (289/3563). The median number of respondents per institution was 5.0 (IQR: 1-9). Of these providers, 62% (179/289) were male and 53% (153/289) were resident physicians. The majority (52%; 69/133) of attending physicians were within 10 years of starting practice and the majority (66%; 101/153) of resident physicians were in their first or second year of training.

TABLE 1. **Institutional characteristics**

Location by census region (%)	
Northeast	11 (24)
Midwest	16 (35)
South	13 (28)
West	6 (13)
Practice environment (%)	
Metropolitan	44 (96)
Non-metropolitan	2 (4.0)
Size in beds (%)	
< 50	16 (35)
≥ 50	30 (65)
Volume in patients/year (%)	
< 75,000	14 (30)
≥ 75,000	32 (70)

N = 46 institutions

Only 17% (49/289) of respondents were aware of the American Urological Association (AUA) guidelines on stone disease.[8,9] There was no difference in awareness between attendings or residents (26/136; 19% versus 23/153; 15%: p = 0.433). The presence of a clinical care pathway designed to deliver evidence based care to a patient with suspected acute renal colic was uncommon (6/46; 13%). Among the 6 institutions with a pathway, 2 (33%) selected a standard-dose protocol non-contrast CT (SD-NCCT), 1 (17%) selected a radiology performed ultrasound (F-US), 1 (17%) selected a low-dose protocol non-contrast CT (LD-NCCT) scan or F-US, 1 (17%) selected a ST-NCCT or a LD-NCCT or a F-US, and 1 (17%) selected a ST-NCCT or a LD-NCCT scan or a point-of-care emergency medicine performed ultrasound (POC-US) as the initial imaging modality outline in the pathway. Overall, the majority of respondents (193/289; 67%) felt that a pathway would be valuable at their primary practice location. However, when compared by role, resident physicians were more likely to desire it than attending physicians (109/132; 83% versus 84/125; 67%: p = 0.006).

Availability of diagnostic imaging at the 46 institutions is outlined in Table 2. Although radiology performed US is technically available at all 46 sites (100%), it was not always accessible 24 hours per day at 7 locations (7/46; 15%). A POC-US is theoretically always accessible, but was only available at 45 institutions (45/46; 98%). A LD-NCCT followed by a POC-US were the most commonly preferred initial diagnostic imaging modalities for a patient with suspected acute renal colic, Table 3. Of those who preferred a SD-NCCT (38/289; 13%), the reason for not choosing a LD-NCCT was because it is not available (25/38; 66%), is less sensitive (4/38; 11%), did not know that a low-dose protocol existed (5/38; 13%), and unknown (4/38; 11%). When selecting a POC-US, their choice was influenced by the fact that it is rapid (75/75; 100%), radiation free (70/75; 93%), readily available (70/75; 93%), performed at the point-of-care (57/75; 76%;), performed by ED providers (55/75; 73%), has good diagnostic performance (33/75; 44%), and is cost effective (61/75; 81%). Preferred initial diagnostic imaging modality was not influenced by respondent role, institution, census region, practice environment, ED size, ED volume, presence of a clinical care pathway, or knowledge of the AUA guidelines (all p > 0.05).

Laboratory evaluation would be performed with a basic metabolic panel (185/289; 64%), complete blood count (96/289; 33%), urinalysis (281/289; 97%), urine

TABLE 2. **Institutional diagnostic imaging availability**

Availability of radiology performed US (%)	
Yes	46 (100)
No	0 (0)
Availability of ED performed point-of-care US (%)	
Yes	45 (98)
No	1 (2.0)
Availability of a low-dose (< 4 mSv) or renal stone protocol NCCT (%)	
Yes	44 (96)
No	2 (4.0)

N = 46 institutions
US = ultrasonography; ED = emergency department
NCCT = non-contrast computed tomography

TABLE 3. **Respondents' preferred initial diagnostic imaging choice**

Standard dose NCCT (%)	38 (13)
Low-dose NCCT (%)	139 (48)
Radiology performed US (%)	31 (10)
ED performed point-of-care US (%)	75 (26)
Plain abdominal radiograph (%)	1 (1.0)
None (%)	5 (2.0)

N = 289 respondents
NCCT = non-contrast computed tomography;
US = ultrasonography; ED = emergency department

TABLE 4. **Respondents' preference for urological consultation**

Indication	Total number of respondents consulting urology (%)
Ureteral stone size*	
< 2 mm	0 (0)
3-4 mm	4 (1.0)
5-6 mm	96 (33)
7-8 mm	144 (50)
9-10 mm	109 (38)
> 10 mm	136 (47)
Not consult	42 (15)
Degree of hydronephrosis*	
Mild	17 (6.0)
Moderate	110 (38)
Severe	168 (58)
Not consult	61 (21)
Signs/symptoms of infection*	
Subjective fevers	30 (10)
Objective fevers	232 (80)
Subjective chills	25 (9.0)
Objective rigors	164 (57)
Urinalysis with leukocytes	107 (37)
Urinalysis with nitrites	173 (60)
Urinalysis with bacteria	149 (52)
Urine culture with bacteria	150 (52)
Not consult	29 (10)
Acute kidney injury	
Yes	216 (75)
No	76 (25)
Persistent symptoms	
Yes	220 (76)
No	69 (24)
Recent prior ED visit	
Yes	60 (20)
No	229 (80)

*multiple responses possible, percentages may not add up to 100%
N = 289 respondents
ED = emergency department

culture (79/289; 27%), and no testing (7/289; 2%). To control symptoms, respondents would utilize a non-steroidal anti-inflammatory (256/289; 89%), antiemetic (208/289; 72%), and narcotic (189/289; 65%). Other medications commonly administered in the ED would include intravenous hydration (178/289; 62%), a urinary selective alpha-blocker (149/289; 52%), and an antibiotic (6/289; 2%). Table 4 displays respondents' preference for urological consultation for a range of indications. Not surprisingly, attendings were more likely than residents to consult urology for absolute indications related to signs and symptoms of infection. For example, in patients with objective fevers, 89% of attendings would consult, while only 73% of residents would do the same ($p = 0.001$). At the time of discharge, respondents would commonly initiate medical expulsive therapy (237/289; 82%) and recommend follow up with a urologist (215/289; 74%), often within 1 (131/289; 45%) or 2 weeks (134/289; 46%).

Discussion

In this cross-sectional survey of academic emergency medicine providers, we demonstrated minimal use of clinical care pathways, although these were highly desired, particularly by resident physicians. We observed that diagnostic imaging modalities with reduced radiation were readily available, and that a LD-NCCT would be commonly preferred. Preference for imaging was not associated with several demographic or institutional characteristics. We found that utilization of urological consultation would be variable, and was influenced by provider role.

The AUA published an evidence based guideline on the management of ureteral calculi and clinical effectiveness protocols for imaging in the management of ureteral calculi in 2007 and 2013, respectively.[8,9] Since these two documents were published in the urological literature and focused on surgical treatment, we hypothesized that awareness of them would be low amongst ED providers. This was confirmed with only 17% of respondents acknowledging their existence. Despite this, we anticipated other measures of quality care would be present, such as local clinical care pathways. However, we observed that only 13% of institutions identified the presence of a clinical care pathway, which is identical to the value reported in 2009.[17] There was a desire for incorporation of clinical pathways into practice, particularly amongst resident physicians (residents 83% versus attendings 67%, $p = 0.006$). This may reflect their stage of training in which they desire prescribed models of care, which they can then assimilate into routine practice.

Previous analyses of the National Hospital Ambulatory Medical Care Survey have demonstrated an increasing use of CT as the primary imaging modality for the diagnosis of symptomatic ureteral stones in the ED.[3,4,6,7,13] The rate of CT and US usage in these analyses ranged from 25%-71% and 2.4%-6.9%, respectively.[3,4,6,7,13]

However, the last update was in 2009. Therefore, little is known about contemporary imaging utilization. Furthermore, these administrative databases do not include information about LD-NCCT or POC-US. In our survey, we attempted to bridge this gap.

With identification of the harms of ionizing radiation[18] and the principle of As Low As Reasonably Achievable,[19] evidence based guidelines recommend a LD-NCCT,[8,20] which maximizes detection of any ureteral stone (low-dose 90% and 99% as compared to standard-dose 98% and 97% for sensitivity and specificity, respectively), while minimizing the effective dose of radiation.[8,11] In this study, we observed a LD-NCCT was the single most preferred (48%) initial diagnostic imaging modality. However, this is not what is observed in actual clinical practice. A recent analysis of the National Radiology Data Registry demonstrated only a minority (2%) of renal stone protocol CT performed in the United States from 2011-2013 were low-dose (< 3 mSv).[10] A possible explanation is that the majority of institutions contributing to this registry are community hospitals, as opposed to our respondents, which are all affiliated with an academic hospital. Furthermore, it is also possible that what a provider would order is different from what actually is ordered or performed. Future analyses will be needed to determine if current provider intentions will translate into a real-world increase in LD-NCCT.

US is an accepted alternative imaging strategy for the evaluation of acute renal colic.[8] In the ED, this is largely with POC-US. In fact, in our study, POC-US was highly accessible with only a single institution (2.0%) reporting its absence. Furthermore, it was the second most preferred (26%) initial imaging modality. The almost universal accessibility of POC-US is likely a result of it being a required skill of emergency medicine training.[21] Furthermore, it is rapid, easy to use, radiation-free, and has a good diagnostic performance for detecting clinically significant ureteral stones,[21] all factors which were confirmed by our respondents. Its use will also likely continue to grow in the acute care setting with a recent randomized controlled clinical trial demonstrating that US, including POC-US was as accurate as CT, but resulted in lower radiation exposure without an increase in adverse events.[12] With the growing body of evidence supporting the use of POC-US in the ED we may have to shift our care paradigm to one which places more emphasis on this modality.

Once diagnostic imaging confirms a symptomatic ureteral stone, then an ED provider makes a clinical decision regarding disposition. Admission for an episode of nephrolithiasis from the ED is approximately 12%-20%.[2,5] Therefore, the majority of patients are seen and discharged directly from the ED.[2] The use of urological consultation in this group of patients remains largely unknown. In a retrospective review of a single academic ED, urological consultation occurred in only 11% of patients diagnosed with symptomatic ureteral stones over a 2 year period.[22] In our study, we found that stone size, degree of hydronephrosis, signs and symptoms of infection, presence of acute kidney injury, and persistent symptoms were all common indications ED providers would use for immediate urological consultation. Certainly, additional factors such as patient reliability, established care with a urologist, availability of urologist follow up, and comorbid medical conditions all influence motivation for consultation, and were not assessed in this study.

We expected that all respondents would consult urology for a patient with acute renal colic in the setting of infection, as this is an emergency requiring urgent decompression. Even in contemporary series this condition is associated with an 8% sepsis rate and a 0.2% mortality rate.[23] However, we observed that this is not the case. In fact, only 80%, 60%, and 52% of respondents would consult urology for what we consider to be absolute markers of infection in objective fevers, urinalysis with nitrites, and urine culture with bacteria, respectively. A possible explanation for this is a lack of knowledge or experience during training of the potential severity of urinary tract obstruction with infected urine. This was confirmed when we stratified the responses by respondent role. Attendings were more likely to consult urology than were residents in the setting of objective fevers (89% versus 73%, $p = 0.001$). Another possibility is that the clinical context of the patient (e.g. presenting symptoms, vital signs, etc.) and not a single indication in isolation would dictate ED providers' use of consultation. Furthermore, it is also possible that these patients are rapidly admitted to a higher level of care, and the consultation is performed outside the ED. Nevertheless, future collaborative efforts focusing on education are necessary and standardized criteria for urological consultation within the context of a clinical care pathway may also help to reduce clinical variation.

There are several limitations to our study. First, this study has the limitations of any self-reported questionnaire study.[24] This survey was not previously validated as a metric to measure ED provider perceptions. However, we did perform a pilot with a convenience sample of local academic ED providers to ensure that to the best of our knowledge it accurately and comprehensively captured their practice patterns. We only assessed hypothetical or belief questions regarding their care of an index patient. Therefore, it is possible that the responses are degraded by recall

bias. Furthermore, this is a cross-sectional survey examining a single point in time. Therefore, it is also possible that what a provider would order is different from what actually is ordered or performed in the future. Despite these limitations of utilizing a survey design, this study does provide additional information about current practice patterns not available through analysis of administrative databases.

Although we attempted to obtain a representative distribution of all emergency departments within the United States, we were only able to compile a list of academic affiliated institutions. Therefore, the results here would not be generalizable to non-academic practices. Furthermore, we were only able to obtain the contact information for the program director and coordinator of each institution, and then relied on them to distribute our survey to their providers. We achieved a contact rate of 29% representing 46 of 156 academic emergency medicine programs, which we believe represents a reasonable cross-section of these institutions. It is possible that the remaining hospitals which did not respond to the survey may have significantly different characteristics. To assess for bias, a sensitivity analysis was performed to determine differences in institutional and residency program characteristics between residency programs who had at least one contact and those who did not have a contact. No differences were observed between the two groups with respect to ED bed size ($p = 0.9$), ED volume ($p = 0.7$), total number of residency positions available at the program ($p = 0.1$), total number of teaching faculty ($p = 0.1$), and total number of potential respondents from each program eligible to receive the survey ($p = 0.4$).

When examining institutional level variables, we did notice discrepancies between respondents from the same institution. This occurred only for the questions related to the presence of a clinical care pathway and the availability of diagnostic imaging. In almost every case, only 1 respondent answered in contradiction to all the other respondents. Therefore, we felt confident that the majority reflected the true response for that particular institution. Interestingly, residents were more often responsible for the discordant responses when asked about the presence of a clinical care pathway, but attendings were more often responsible for the discordant responses when we asked about imaging availability. We acknowledge that utilizing the majority is a limitation, as the discrepancies could signal true differences in resource availability, although we think this is unlikely. More likely is that this is related to a lack of knowledge of what is actually available at a given institution, and further study will be needed to clarify this concept.

Our true response rate is unknown, but we admit likely low. We were able to estimate it based on known program characteristics with a calculated response rate of 8.1%, which is similar to a previous comparable study.[17] Furthermore, physician surveys commonly have low response rates and this does not necessarily make them less valid.[25] Previous literature has also demonstrated that response rate should not be used as a proxy for response bias.[26] Therefore, this suggests that our results are valid and provide insight into the current practice patterns of emergency medicine providers.

Conclusion

In this cross-sectional survey of academic emergency medicine providers, we further defined current practice patterns for an episode of acute renal colic by exploring implementation of quality initiatives, preference of diagnostic imaging modalities with reduced radiation, and use of urological consultation. By examining these areas, future collaborative efforts can be focused on reducing clinical variation and enhancing the delivery of quality care. □

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