Audit of ureteric calculi measurements in patients who undergo CT KUB

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Purpose

Information regarding calculus location, size as well as complications of hydronephrosis and perinephric collection/abscess are essential for determining the management pathway in patients with renal tract calculi.

This information is required for the Urologist to determine the likelihood of the patient being able to pass the calculus using medical expulsion therapy or need for surgical intervention\(^1\).

While there is a consensus on the window level and width for measurement of calculi \((1120/300)\) \(^2\), currently there is no universal radiological guideline for the technique of calculus measurement \(^3,4\). However, there have been numerous studies that have shown that measuring the maximal width of the calculus on coronal reformats correlates most accurately with actual stone size collected post-operatively compared to measurements taken on axial imaging \(^1,5\).

Calculi sizes differing by a few millimeters can determine the disposition of a patient as typically a calculus less than 4.6mm will pass spontaneously while a stone greater than 6mm will need intervention\(^1\).

The aim of this study was to audit the accuracy of calculus measurement in patients with ureteric calculi confirmed on CT KUB.
Methods and materials

A retrospective study was conducted at St Vincent's Hospital, Sydney.

All CT KUBs between the period of January 2016 to the end of January 2017 were reviewed.

Inclusion criteria:
- Ureteric calculi
- All referrals including inpatients and outpatients

Exclusion criteria:
- Renal calculi
- Vesical calculi

Data collected included:
- Demographics: age, sex, disposition
- Location of calculi: proximal, mid or distal ureter
- The number of calculi identified on each study
- Reported measurement of calculi
- Reported axis of calculus measurements (anterior-posterior, width and/or cranio-caudal lengths)
- Reported window level used to measure calculi
- Presence of saved images
- The maximal width of the calculi in the plane of the ureter course were re-measured on coronal reformats using the window level/width of 1120/300.

The collected data was tabulated in an excel spreadsheet. The difference in reported and study measurements were analysed.
Results

All CT KUBs from the beginning of January 2016 to the end of January 2017 performed at St Vincent's Hospital, Sydney were reviewed totalling 818.

Two hundred and sixty eight studies (33%) were positive for ureteric, 41 (5%) for renal and 14 (2%) were positive for vesical calculi.

A total of 39 (15%) of studies were accurate in calculi measurement.

In 19 (7%) studies, the calculus was undermeasured while 210 studies (78%) showed overmeasurement.

The average millimeter of undermeasurement was 0.6mm and the average over measurement was 1.4mm.

The largest proportion of calculi were identified in the distal ureter (61%), followed by the mid and proximal ureter (13% and 26% respectively).

The average size of ureteric calculi in the proximal, mid and distal ureters were 3.6mm, 3.5mm and 2.5mm respectively. Calculi located in the proximal and mid ureter were most accurately measured with an average difference of 1mm and 0.9mm respectively while distal ureteric calculi had an average difference of 1.5mm.

The majority of positive studies did not have an image of the calculus with axis of measurement saved totalling 221 (82%) while only 61 (23%) showed this.

Of the saved images, 41 (67%) were saved in axial reformats with 10 of these saved in bone windows and 36 images saved in soft tissue.

Only 4 studies had images saved in coronal reformats and these were in soft tissue windows.

Thirty one (12%) studies documented their corresponding axis for their measurements within the body of the report.

Only 3 out of the 39 accurate calculi measurements documented coronal reformats in bone windows as the method of measurement.
Conclusion

Performing CTKUBs in our department makes up 11% of abdominal examinations in a year using CT and the majority, 81% in this case series were referred from the Emergency Department (ED). Therefore the accurate measurement of ureteric calculi is important in assisting patient flow and resource allocation for the ED and Urologists.

A few millimeters difference in the size of a calculus can determine whether a patient can pass it spontaneously, usually if less than 4.6mm while a calculus greater than 6mm will most likely require medical expulsion therapy either as an out/inpatient or surgical intervention\(^1\).

While there is no international consensus on measurement of ureteric calculi, numerous studies have shown that measuring the maximal transverse dimension of the calculus on coronal reformats correlates most accurately with actual stone size\(^1,5\).

Nazim\(^1\), Metser\(^6\) and Nadler\(^7\) et al have shown that axial images consistently undermeasured calculus size by 13-20% compared to the coronal plane. While our study showed a small proportion (7%) of calculi were undermeasured, our findings were comparable to the previous studies with the maximal diameter 19% less on axial images compared to coronal.

In this study, the majority (78%) of calculi were overmeasured particularly in the distal ureter. The reasons could be threefold:

1. This could be secondary to the loss of resolution when magnifying the image. Close to 70% of calculi were located within the distal ureter and these calculi were 30% smaller in size compared to those in the proximal ureter.

2. Measuring calculi in soft tissue window results in overmeasurement due to streak artefact (see Figures 1 to 4.) and bone window allows for better definition of the stone edges.

3. Measuring calculi in reformats other than the coronal plane may not be a true reflection of the maximal width of a calculus.

Coronal reformats have shown to be a more accurate method for measuring maximal calculi width especially for those that are orientated in the vertical plane\(^8\). It also enables
visualisation of the kidney, ureter and bladder simultaneously in a plane that is almost parallel to the orientation of these organs\(^9\).

Only a small proportion of studies documented the axis and window of calculus measurement in the body of the report or through saved images.

As a result of the audit, a standardised protocol for measurement of ureteric calculi will be implemented in our department to ensure consistency. A new audit cycle will then be undertaken to monitor progress.
Fig. 1: Left VUJ calculus in soft tissue window. Streak artefact results in less well defined margins. Compare with Figure 2.

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Fig. 2: The same left VUJ calculus in window level/width of 1120/300 results in reduced streak artefact and better defined borders.

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Fig. 3: Left VUJ calculus measuring 3.8mm on soft tissue window setting. Compare with Figure 4.

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Fig. 4: The same left VUJ calculus measuring 2.8mm on bone window setting.

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References


