Seasonal Variation of Acute Urolithiasis at an Australian Tertiary Hospital

Albert Tiu[1], Vincent Tang[1], Samuel Gubicak[2], Paul Knight[1] and Hodo Haxhimolla[1]

[1]Department of Urology, The Canberra Hospital, Australian Capital Territory, Australia

[2]Australian National University, Canberra, Australian Capital Territory, Australia

RESEARCH

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Corresponding Author:
Vincent Tang
The Canberra Hospital
Yamba Drive
Garran 2605
Australia
Vtang77@gmail.com

Abstract

Background
Urolithiasis is a common condition. It often affects patients in the prime of life causing significant burden to the society. In our study we are interested in determining whether seasonal variation is a risk factor of acute urolithiasis.

Method
A retrospective study was performed at a tertiary hospital in Canberra, ACT, Australia. Data pertaining to patient demographics, history of renal colic and management were extracted from charts over a 10-year period. Climatic data for the Australia Capital Territory during this period was retrieved from the Australian Bureau of Meteorology and correlated to renal colic presentations.

Results
Data was obtained for 637 patients all with radiologically confirmed calculi of the urinary tract. The median age at diagnosis was 50 years of age. Overall 37.4% of patients had a previous history of urolithiasis and the male to female ratio was 2.8:1. Presentation was most common in the autumn months (32.8%), with the fewest cases of urolithiasis during the winter months (18.7%). At presentations the majority of the calculi were ≤ 5mm and located within the distal ureter. Conservative treatments were instituted more often when stone size was ≤ 5mm. Proximal ureteric calculi were more likely to be treated with surgical intervention.

Conclusion
We demonstrate an association between the presentation of primary urolithiasis and season. A better understanding in the subject may help future health care planning to deal with the seasonal increase in presentations of renal colic to the urology service.

Key Words
Calculi, humidity, season, temperature

Background

Urolithiasis is a common condition. About one in eight men and one in twenty women will develop a stone within their lifetime. Recurrence rates are high and those who form calculi have a 10% recurrence rate at 1-year [1]. Urolithiasis affects people in the prime of life and in addition to causing pain and suffering; it causes a loss of productivity with time away from work. In western societies urolithiasis accounts for 16% of all urological admissions and 1–2% of total hospital admissions [2].

A number of important risk factors pertaining to urolithiasis include age, sex, diet, water intake; body weight and past history have been well documented[3]. The effect of season and geographical location is however equivocal. Several studies of urolithiasis in Emergency Departments in the Northern Hemisphere, have demonstrated a seasonal variation in urinary calculi formation [1, 4].

An understanding of factors such as seasonal variation in the formation of urinary calculi has implications for health care planning as well as the management and advice given to patients. Australia is the world's driest inhabited continent[5,] and Canberra in Australia has a well define four seasons variation; if a seasonal effect is universal and temperature-dependent then we expect an increase in renal colic visits in the warmer months. The purpose of this study was to determine if urolithiasis presentations in an Australian hospital exhibited seasonal patterns.

Method

This is a retrospective review of acute renal colic presentations to the emergency department at The Canberra Hospital. The hospital is a tertiary referral centre which provides specialist and acute care to more than 500,000 people in Australia Capital Territory (ACT) and

surrounding South-Eastern New South Wales. Eligibility for the study was defined as those individuals presenting with new acute renal colic with radiologically-confirmed urolithiasis, re-presentations were excluded. Information was collected from hospital records regarding patient demographics, personal past history of renal colic and details of management. Climatic data for the ACT during this period were retrieved from the Australian Bureau of Meteorology and seasonally correlated to renal colic presentations. **T**he data was analysed using goodness of fit tests to assess for statistical significance. A p-value < 0.05 was considered statistically significant. Statistical analysis was performed using the R statistic package (R Development Core Team, Vienna, Austria).

Results

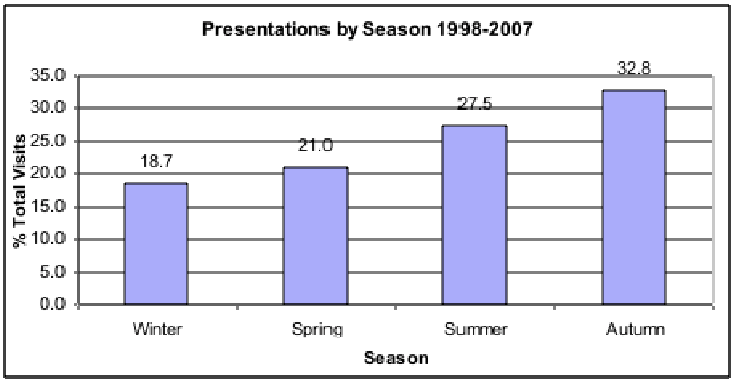
A total of 637 patients presented with radiologically confirmed urolithiasis from 1st January 1998 to 31st December 2007. The ratio of male to females was 2.8:1. Middle aged males and females aged between 40 to 59 years, showed the highest rate of presentation. Overall 37.4% had a previous history (Table 1).

Table 1: Patient demographics

	Male		Female	
Total	483		154	
Median age (Range)	51 (12-90)		50 (24-85)	
	Frequency	%	Frequency	%
<19	3	0.6	0	0
20-29	34	7.0	9	5.8
30-39	67	13.9	26	16.9
40-49	123	25.5	39	25.3
50-59	124	25.7	40	26.0
60-69	75	15.5	23	14.9
>70	57	11.8	17	11.0
Personal history	186	38.5%	52	33.8%
Background				
Caucasian	456	94.4%	140	90.9%
Asian	20	4.1%	11	7.1%
Aboriginal	4	0.8%	0	0%
Pacific Islander	1	0.2%	1	0.6%
African	2	0.4%	2	0.6%

Season, temperature and humidity (Figure1 and Figure 2)
We found a significant association between the number of presentations and the season (χ^2=31.27, df=3, p < 0.001) with a significantly higher number of presentations in autumn months. Presentation was most common in the Australian autumn months, namely between March and May (32.8%), with the fewest documented cases of primary urolithiasis during the Australian winter months between June to August (18.7%). However, highest temperature or lowest humidity does not appear to have a direct influence on the number of presentations.

Figure 1: Presentations of acute urolithiasis by a) season and b) month



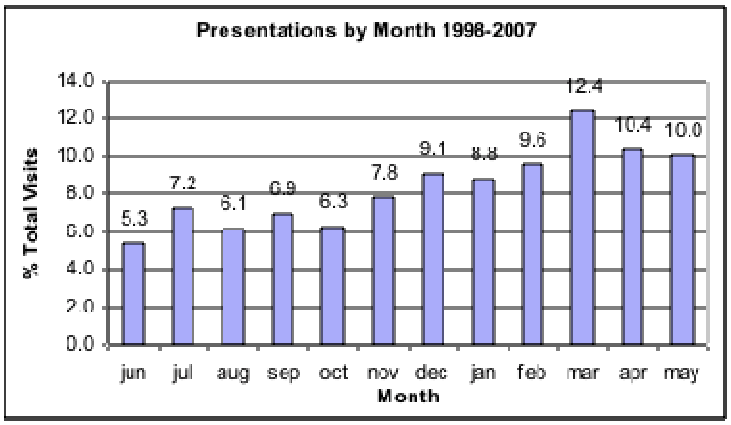
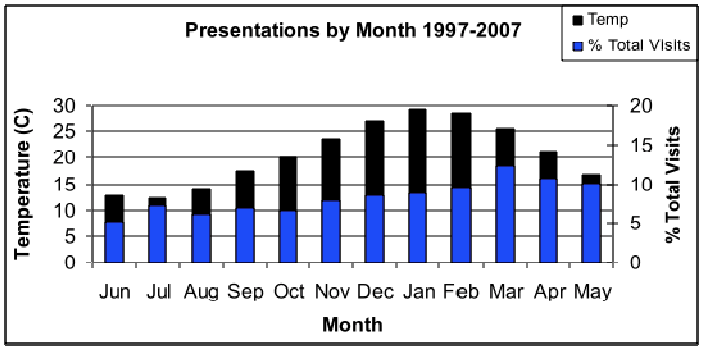
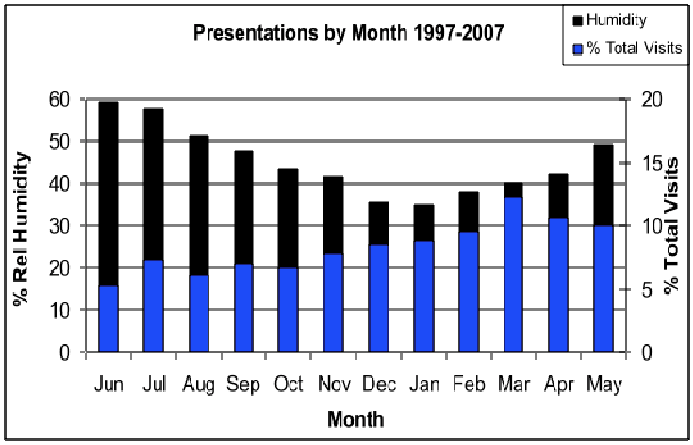


Figure 2:
a) Presentations and average maximum temperature in ACT 1998-2007[6]



b) Presentations and average relative humidity in ACT 1998-2007[6]



Stone size (Table 2)

At presentation the majority of calculi were small (53.8% <5mm) and located within the distal ureters (47.4%). There is no association between stone size and season of presentation (p=0.26). Stone size is significantly related to management approach (χ^2=154.06, df=2, p < 0.001). Conservative measures are instituted significantly more often when stone size is ≤ 5mm. There is a significant association between location of stone and management instituted (χ^2= 155.56, df = 3, p < 0.001). Stones in the proximal ureter are managed surgically significantly more often (p<0.001), while stones located in the distal ureter were managed conservatively for a greater majority or the time (p<0.001).

Table 2: Stone characteristics a) size and b) location

Size (mm)	Frequency (%)
≤5	343 (53.8%)
6-10	236 (37.0%)
11-15	40 (6.3%)
>15	18 (2.8%)
	Median stone size (mm)
Season	
Winter	5.0
Spring	5.0
Summer	5.0
Autumn	6.0

Stone Characteristics	Frequency (%)
Side of renal colic	
Right-sided	325 (51%)
Left-sided	312 (49%)
Stone Location	
Renal	112 (17.5%)
Ureteric	
Proximal	191 (30%)
Mid	31 (4.9%)
Distal	303 (47.6%)
Management	
Conservative	339 (53%)
Surgical	298 (47%)

Discussion

Our study has shown a seasonal variation in presentations of urolithiasis. Presentations were highest during the Australian warmer months December to May. During the study period the mean maximum temperatures in the ACT ranged from 28.3ºC in summer to 13.1ºC in winter, likewise humidity ranged between 36.0% in summer to 56.0% in winter. When humidity is low, moisture on skin can evaporate freely. If the temperature is also high the body's ability to cool through the evaporation of perspiration is diminished. Higher average temperatures during summer could lead to increased water loss through perspiration and lower urine volume. During the warmer months dehydration through perspiration is therefore thought to play an important role in calculus formation[7]. Bescolo-Berto et al[8] recently demonstrated a negative correlation between humidity and renal colic using computer modeling. An association was made between the onset of renal colic and exposure to hot and dry weather. This effect was higher when temperatures rose above 27°C and relative humidity fell below 45%. During the summer months in the ACT region, both the average maximum temperatures and the average relative humidity levels were above this threshold.

Nevertheless, one of the main differences from previous studies is that presentations in our study were not highest during summer, the warmest period; rather a peak was seen during the autumn months. The kinetics of stone formation is poorly understood. The length of time required for calculus formation, and period between exposure and symptomatic urinary stones have not been defined. It is possible that differences in length of exposure to warm and dry periods accounts for the discrepancy. Our findings suggest that a lag period exists between exposure and manifestation as renal colic. We speculate that stones start forming during the hot summer months until they reach a critical size to cause symptoms before presentation, and hence the lag in presentation during autumn.

Our study also showed that patients with stones more than 5mm and proximal ureteric stones are more likely to have surgical interventions rather than conservative management, as the chances of these stones being passed spontaneously are less likely as compare to smaller (< 5mm) and distal ureteric stones respectively[9]. This is conforming to the American Urological Association (AUA) guideline. Therefore, we expect much higher stone case workload during the summer and autumn months.

The findings from this study suggested that stone cases workload increases by 1.5 times during summer and autumn seasons as compared to winter and spring seasons. We believe these findings may have an impact on planning of the future healthcare provision as well as patient's education strategies. Arguably, timely health campaigns for renal stone prevention such as patients information campaign to encourage increase fluid intake to >2L per day or achieve urine output >2.5L per day[11] should be instigated during summer and autumn seasons. In addition, healthcare provision for stone management should be increase during the summer and autumn seasons, such as, a transient increase in operating time slots for stone cases and more effective use of mobile lithotripsy service, in order to reduce the number of ureteric stents in situ and its associated complications[10] as well as reduces number of renal tract stones left in situ which can potentially cause infection, hospitalisation associated burden of health care and number of days off work by patients.

Conclusion

This study has demonstrated an association between the presentation of urolithiasis and season. It is suggested that a lag period exists between exposure to warmer and drier periods and manifestation as renal colic. This means an increase in urinary tract stone workload during this period. Therefore, healthcare prevention and dynamic healthcare planning should be instigated to reduce socioeconomic burden secondary to sharply increases of stone case presentations due to a predictable seasonal variation pattern.

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PEER REVIEW

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CONFLICTS OF INTEREST

Nil.