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ORIGINAL PAPER

M. A. Chang · D. S. Goldfarb

Occupational risk for nephrolithiasis and bladder dysfunction in a chauffeur

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Abstract The occupational risks for nephrolithiasis have not been widely studied. The published literature focuses on exposure to heat stress and toxic substances, not on the equally important behavioral risk factor of limited water consumption over many years. Urologic morbidity has been associated with suppressing the need to drink or void under restrictive work environments; however, no such studies link work related behavioral change with the development of kidney stones. This case report is the first to associate a restrictive work environment with limited fluid consumption, resulting in the development of nephrolithiasis.

Keywords Urinary urolithiasis · Occupational disease · Behavioral factors · Dehydration · Hyperoxaluria

The literature is limited that reports on the risks of nephrolithiasis associated with various occupations. Occupations that have been reported to increase stone risk include work in hot environments, where there is increased insensible water loss such as sweat and a limited ability to replete it. For example, lifeguards, machinists, and outdoor laborers experience a 4- to 20-fold increased risk of nephrolithiasis when compared to control subjects [1, 2, 3]. Other studies suggest that toxic exposures to industrial materials such as cadmium and oxalic acid are associated with an increased risk of stone disease [4, 5]. This case report serves to highlight another occupation that, mediated by a different mechanism, potentially increases the risk for the development of nephrolithiasis.

M. A. Chang
2 North Medical Clinic, Module E,
Bellevue Hospital, 462 First Ave.,
New York, NY 10016, USA

D. S. Goldfarb (✉)
Nephrology Section/111G,
New York DVAMC, 423 E. 23 St.,
New York, NY 10010, USA
E-mail: david.goldfarb@med.va.gov
Tel.: +1-212-6867500 ext. 3877

Case

A 54-year-old man, a professional driver for many years, presented to the urology clinic for symptoms of nocturia and increased frequency of urination. Testing of urodynamics revealed a hyposensate, hypocontractile dilated bladder without evidence of a mechanical obstruction. Ultrasound examination of the kidneys showed multiple, bilateral asymptomatic stones. No plain radiograph was available to determine the radiodensity of the stones. His past medical history was noncontributory: he had never been hospitalized and did not have gout or hypertension. He took no medication at the time of presentation. The social history was significant as he had chauffeured for a wealthy and demanding man who traveled frequently. The patient reported that he was not allowed to stop the car to urinate on many long trips and avoided drinking any liquids before driving. He often drove from New York to Vermont, a distance of more than 300 miles, over 6 to 7 h, without being allowed to stop. The employer had recently died and the patient was now driving for his more liberal daughter. He reported drinking considerably more fluid now than while driving for his employer's father. His diet was well rounded with a high intake of pork and pasta, but little dairy intake. The family history was significant, with kidney stone disease in a daughter and nephew. No members of the family had other related genitourinary or metabolic problems.

His bladder dysfunction was treated with terazosin 1 mg at bedtime, and with clean intermittent urethral catheterization. He was then referred to the kidney stone prevention clinic for further evaluation of his bilateral stones.

On physican exam, the patient was 175.3 cm tall and weighed 100.7 kg, for a body mass index (BMI) of 32.9. This BMI meets the definition of obesity. Serum testing revealed normal results except for hyperuricemia with a serum uric acid concentration of 8.0 mg/dl; the creatinine concentration was 1.0 mg/dl, potassium 4.5 meq/l, bicarbonate 27 meq/l, and calcium 9.4 mg/dl. We collected two 24-h urine samples and calculated mean results (Table 1). The results were significant for urine volumes of more than 2 l, hyperoxaluria, hyperuricosuria, normocalciuria and excessive sodium excretion in each 24-h sample. The supersaturation of calcium oxalate, calcium phosphate and uric acid, calculated by EQUIL2, were low. The protein catabolic rate (PCR) was at the high end of the normal range.

The patient was referred to a dietician who found that the patient's diet was high in fat, largely related to an excessive intake of beef. The patient was advised to reduce beef, fat and salt intake,

Table 1 Mean values of two 24-h urine collections

	24 h urine collection (mean value)	Normal range
Volume (L)	2.4	0.5–4
Calcium (mg/d)	131	<250[a]
Citrate (mg/d)	1217	>450 *
Oxalate (mg/d)	49	20–40
Uric acid (g/d)	1.2	<0.8[a]
pH	6.2	5.8–6.2
Sodium (meq/d)	335	<100
Potassium (meq/d)	150	20–100
PCR (gm/kg/d)	1.3	0.8–1.4
Supersaturation	–	–
Ca Oxalate	2.9	6–10
Ca Phosphate	0.6	0.5–2
Uric acid	0.7	0–1

[a]Normal ranges provided are for men. Ca, calcium; Na urate, mono-sodium urate. PCR, protein catabolic rate, a calculated estimate of ingested protein

and increase fiber intake to address hyperlipidemia. He was encouraged to maintain his high fluid intake to maintain low supersaturations of stone-forming solutes.

Discussion

In this case, the limitations to fluid consumption and voiding likely contributed to the development of kidney stones and a dilated, poorly functioning bladder. The lack of convenient toilet facilities and the demands of the employer contributed to consuming less fluid, and to conscious suppression of the need to void. The effect was an increase in the urinary supersaturation, with resultant kidney stone formation, and the development of a large capacity bladder. The results of the 24 h urine revealed mild hyperoxaluria and hyperuricosuria, both possible risk factors for stone formation. Although we do not have a 24 h urine collection under working conditions, either of these factors, at least in part attributable to dietary intake, may have predisposed the driver to stone formation when a low urine volume was superimposed. The patient's obesity is also a risk factor for stone formation [6] In contrast it is also possible that, given these risk factors, the driver would have formed these stones regardless of the rigidity of his employer. However, the low supersaturations with adequate urine volumes suggest that a less rigid work regimen might not have been associated with stone formation, even with his present dietary intake, emphasizing the importance of behavioral changes under occupational stress. Although the composition and radiodensity of the stones were not determined, a low urine volume could have contributed to a risk for both calcium oxalate and uric acid stones.

The effect of work conditions on drinking and voiding habits have been documented in studies examining voiding habits of teachers and nurses, and their possible association with urinary tract infections. We are not aware of any studies of this type for nephrolithiasis. One study by Nygaard found that 397 of 791 teachers surveyed consciously drank less in order to decrease the anticipated frequency of urination [7]. The decreased fluid consumption was associated with an increased risk of urinary tract infection symptoms when compared to the teachers who drank without restriction (21% vs. 10%). The importance of limited water consumption as the cause of urinary concentration and the risk of nephrolithiasis was documented by Embon in a retrospective study [8]. The study found that in 98 stone formers whose disease resulted from chronic ''dehydration,'' a hot climate, poor water ingestion and a hot occupation were cited as the most common causes. The authors reported that 61 of the 98 cases reported a single cause of dehydration, and low fluid intake comprised 28% of these. Our driver was not under heat stress in the climate-controlled limousine, but the behavioral limitation to fluid consumption was the source of his presumed urinary concentration and stone disease.

The finding of a large capacity bladder in our patient in the absence of a mechanical outlet obstruction is likely associated with the suppression of the urge to void over many years. We do not believe that the dilated bladder, in the absence of any evidence or history of urinary tract infection, contributed to stone formation. Although not directly related to kidney stone formation, this finding supports his history of limited opportunities to urinate. An infrequent voiders syndrome has been suggested by studies associating decreased voiding frequency with increased bladder capacity, and a greater risk for urinary tract infections [9]. The prevalence of infrequent voiders syndrome was 8.3% in a group of nurses on a busy surgical ward. Although only six subjects fulfilled the criteria for infrequent voiders syndrome, 50 of 72 subjects reported suppressing the urge to void due to busyness at work. This study, besides providing a possible etiology for the enlarged bladder in our driver, emphasizes the restrictive nature of work environments, and their impact on voiding habits. There are no epidemiological studies targeting drivers and their prevalence of nephrolithiasis. One survey with a subset of only 24 drivers did not demonstrate an increased prevalence of stone disease [10] but the sample size is very small. Those drivers who are self-employed, or not under the constant scrutiny of employers, may not experience an increased prevalence of nephrolithiasis.

Conclusion

The medical literature on the occupational risks of nephrolithiasis focuses on chronic dehydration related to ambient heat, and not on chronic dehydration due to limited water ingestion. Our case report is the first to associate a behavioral change in drinking habits due to work restrictions with the risk of nephrolithiasis. This

may be an important contributor to stone prevalence, particularly in patients with other risk factors such as diet. Occupations with strict regulations on toilet breaks, work environments with poor toilet facilities, or work duties which interfere with drinking or voiding habits may all carry a greater risk for kidney stone formation.

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