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STONES: Passing a stone in your sleep might be easier than you think

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Abstract

Passing kidney calculi can be excruciatingly painful for patients, likened to childbirth in intensity. The mechanism of the simple act of passing a stone, however, is not well understood. A recent research article examined a novel approach for optimizing kidney stone clearance—sleep position, a simple noninvasive concept that might improve urinary stone passage.

Shockwave lithotripsy (SWL) is a common treatment for kidney stones. SWL breaks up stones without the need for an incision and relies on the body to pass the fragments through the urinary tract. Identifying ways to pass these fragments more reliably and safely could significantly improve efficacy of SWL treatment and postoperative pain, while also reducing costs to the health-care system. A new finding illustrates that sleep position can impact stone fragment passage after SWL.¹ In this study, body position (recorded in a sleep laboratory) was documented on the first night after SWL in patients treated for stones smaller than 2 cm. Electromagnetic impulses recorded patient position and individuals were subsequently categorized as spending >50% of their time sleeping either stone-side down or non-stone-side down—referred to as ipsilateral or contralateral sleeping, respectively. Patients were excluded if they slept mostly on their stomach or back or spent most of the night changing between positions. Powered appropriately to assess for a 20% difference in 3-month stone clearance rates, 120 patients were studied; 60 in each group sleeping either ipsilaterally or contralaterally.

Neither medical expulsion therapy nor perioperative ureteral stents were utilized. Patients were followed with radiography of the kidneys, ureters and bladder and ultra-sonography every 2 weeks for 3 months. Stone-free status was defined as <4 mm of stone remaining. In each group, about 62% of total sleep time was spent on either the ipsilateral or contralateral side during the first postoperative night. The groups did not differ in the total number of SWL sessions required or their need for additional intervention to remove remaining calculi. 88.3% of patients who slept stone-side down were stone free at 3 months after SWL compared to 70% of those who slept stone-side up. The odds ratio for stone-free status at 3 months was 3 times higher in ipsilateral sleepers than contralateral sleepers.

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Competing interests

The authors declare no competing interests.

The authors attributed the improved stone-free clearance rate to increased renal blood flow on the ipsilateral side in ipsilateral sleepers. Other researchers have demonstrated that stone clearance is decreased by impaired kidney function.² Renal blood flow and renal perfusion, as measured with nuclear scintigraphy, were significantly increased in the dependent kidney when healthy volunteers (generally young and nonobese) were positioned in the lateral decubitus position for as little as 30 min.³ Using patients as their own internal controls, it was demonstrated that 80% of patients lying in a lateral decubitus position with the left side down had demonstrably increased renal perfusion in the dependent kidney and 90% of patients who lay with their right side down had similar increased perfusion. These findings are in concordance with the authors' point that the dependent kidney experiences increased bloodflow.

An age-old enigma in the urology community is why most people form kidney stones on one side only, despite the fact that they have two functioning kidneys with unobstructed collecting systems. Previously, data have demonstrated that the dependent kidney is more likely to form stones.⁴ Positive predictive values for stone formation in the ipsilateral kidney for right-side down and left-side down sleepers were 82% and 70%, respectively. Thus, previous data reveal that dependent kidneys are more likely to form stones, and the current paper shows that dependent kidneys are also more likely to pass them. Sleep position appears to have a significant effect on the microenvironment of the kidney, increasing renal perfusion of the dependent kidney, which can lead to increased solute filtration and urinary flow to the collecting system. The same physiologic change might lead to both formation and passage of stones under different circumstances, potentially in the same patient. The nature of these circumstances remains unknown.

The pathophysiology underlying stone formation and stone movement within the kidney is not fully understood, an important point highlighted by the authors' discussion. They propose that increased filtration in the ipsilateral kidney might partially explain why ipsilateral sleepers have increased stone passage—as more urine passes through the collecting system on that side, more stones might be cleared. But why do stones form more readily in the dependent kidney? Does increased perfusion lead to hyperfiltration and increased solute deposition where stones then have a propensity to crystallize? Is this a postural phenomenon only or is there local hormonal regulation, changes in ureteral peristalsis, or an unidentified ureteral pacemaker at work here? These are some of the basic unanswered questions that are raised by the findings highlighted in this paper. Thinking of the kidney as a dynamic microenvironment can be used to one's clinical advantage.

One issue that was not addressed in this paper was whether stone passage in this patient population was affected by location of the stone in the lower pole, which has been described previously as a barrier to stone passage in post-SWL patients. Whether this is a result of the infundibular angle to the lower pole, complexity of the calyceal system, calyceal infundibular diameter or length, or stone burden is a subject of current debate.^{5–7} How is it that lower pole stone fragments can overcome their dependent position and pass the physical barriers to reach the ureter? Perhaps there is a unidirectional flow of urine that contributes to this forward progress of stones for passage, a portion of which might be attributable to increased perfusion in the dependent kidney as described by the authors.

The concept that positioning can play a major part in organ perfusion has been appreciated in other fields. In critical care, pulmonary perfusion is heavily influenced by position. For example, sitting, standing, and lying down have been shown to alter both pulmonary perfusion and gas exchange.⁸ This finding has been translated into clinical practice with the use of prone positioning in acute respiratory distress syndrome to improve ventilation of severely ill patients.⁹

In this paper, the effect of positional changes on stone passage rate after SWL was examined, and a statistically significant difference was observed. In this particular case, one might argue that ipsilateral sleeping could potentially be as effective as medical expulsion therapy with an α -blocker for facilitating stone passage. In a clinical setting, asking patients to spend more time in a specific sleep position might represent an effective means of not only preventing stone formation, but also in assisting stone passage. One might apply this concept by asking a patient who is at risk of stone formation (but currently stone free) to sleep on their contralateral side and an individual trying to pass a stone fragment to sleep on their ipsilateral side. This might not be an easy task for patients to accomplish. One potential drawback of this study's design is that they only monitored sleep position during the first postoperative night. Sleep researchers, however, have shown that one's perception of the side they sleep on is accurate and consistent.¹⁰ People tend to sleep on one side habitually, and they are generally fairly good at distinguishing which side it is. Asking a patient to simply change their sleep position to increase stone clearance might not be as straightforward as it seems. Future advances in urologic care technology should perhaps include device development that could assist in changing a person's sleep posture, turning this paper's findings into a clinical application.

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