

STONE DISEASE

Preventing Migration of Stones during Fragmentation with Thermosensitive Polymer

Sacco D, McDougal WS, Schwarz A

Department of Urology, Massachusetts General Hospital, Boston, Massachusetts

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Purpose: To define a method of stabilizing stones during extracorporeal (SWL) and intracorporeal lithotripsy with a thermosensitive polymer.

Materials and Methods: Using a thermosensitive polymer that is either a liquid or a gel, depending on the temperature, both calcium oxalate and plaster of Paris phantom stones were placed in the polymer gel or saline, and SWL was performed. Comparisons were made between the effectiveness of the fragmentation in the two media. Also, in-vivo studies using the polymer to prevent migration of ureteral stones were performed in swine. Electrohydraulic lithotripsy was used on a small stone implanted in the distal ureter with the polymer instilled proximally. Once in the ureter, the polymer converted to a gel. After completion of the procedure, the polymer was restored to a liquid form by infusion of cold saline and expelled from the ureter. Three of the pigs underwent treatment of the stone, convalesced for 7 days, and then had urine collections from both ureters to compare the glomerular filtration rates, fractional sodium excretion, urine/plasma creatinine ratio, and urine/plasma urea ratio on the treated and the contralateral (control) sides.

Results: The polymer did not enhance fragmentation when used with SWL but prevented stone migration in the in-vivo studies. The physiologic parameters were not significantly different on the treated and the control sides. The polymer was easily removed from the ureter by infusing cold water.

Conclusion: The use of this thermosensitive polymer proximal to ureteral stones prevents migration and is not traumatic to the ureter.

Editorial Comment

The authors describe the use of a novel thermosensitive polymer to stabilize calculi during endourological procedures. The technique was not successful in an in vitro model of ESWL. Previous studies have demonstrated inhibition of stone fragmentation by ESWL when a mineral oil medium surrounds the stone. It is thought to occur by interference with the cavitation effects of ESWL, and a similar effect may occur with the new polymer evaluated in this study.

The authors did not evaluate the upper collecting system acutely after intracorporeal lithotripsy in the porcine model. This is an important step to be able to conclude that the polymer did not migrate into the renal pelvis or calyces. Was this to occur, the patient may experience transient obstruction until the polymer dissolved 2 hours later.

Clinical applications of this polymer would require the use of warmed endoscopic irrigation fluid to prevent dissolution of the polymer. It would be important to evaluate the toxicity of combustion by-products of the polymer to determine what might be anticipated if it were inadvertently targeted with the holmium laser. It would also be important to evaluate interactions of the polymer with a ureteral stent left post-operatively – could this impact polymer dissolution?

As such, the polymer holds promise as a method to prevent stone migration during ureteroscopy. One would need to quantify the volume of polymer required, which may vary based on the degree of ureteral dilation above the calculus. One might propose that the polymer could facilitate stone fragment retrieval during PCNL.

Dr. Manoj Monga

Professor, Department of Urology

University of Minnesota

Edina, Minnesota, USA

E-mail: endourol@yahoo.com

Instillation of Skin, Nephrostomy Tract, and Renal Puncture Site with Ropivacaine Decreases Pain and Improves Ventilatory Function After Percutaneous Nephrolithotomy

Ugras MY, Toprak HI, Gunen H, Yucel A, Gunes A

Departments of Urology, Inonu University Faculty of Medicine, Malatya, Turkey

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Background and Purpose: Pain after percutaneous nephrolithotomy (PCNL) is well investigated, but no optimal management strategy has yet been defined. Ventilatory changes after uncomplicated PCNL remain obscure. We investigated whether pain can be managed with a combination of a parenteral non-narcotic drug and instillation of a local anesthetic into the operative field. We also measured ventilatory changes early after PCNL to determine whether this analgesic modality improves ventilatory status.

Patients and Methods: In a randomized blinded study, 34 well-matched patients underwent PCNL with single subcostal access. At the end of the operation, 30 mL of either 0.02% ropivacaine or saline was instilled into the renal puncture site, nephrostomy tract, and skin. Postoperatively, patients received parenteral metamizol (dipyrone) (500 mg/dose) on demand. Pain visual analog score (VAS), peak expiratory flow rate (PEF), and blood-gas analysis were performed at 2, 6, and 24 hours postoperatively. The number of analgesic doses required was recorded.

Results: The VAS at 6 hours, time to first analgesic demand, and total analgesic need were significantly lower ($P = 0.001$, 0.008 , and 0.001 , respectively) in the ropivacaine group, whereas the PEF at 2 and 6 hours was significantly higher ($P = 0.001$ for each). Analgesic use in the first 12 and 24 hours was lower in this group. Blood-gas analysis was within the normal range in both groups. Time of surgery and hemoglobin decrease were not significantly different.

Conclusions: A decrease in PEF indicating restricted ventilation appears early after PCNL. Because these patients were chosen carefully to have normal function preoperatively, this decrease was attributed to nociception. A combination of ropivacaine instillation with metamizol decreases pain and analgesic use and improves PEF more than use of metamizol alone. Such a multimodal pain-management strategy is effective in minimizing postoperative opioid use with proper pain management, resulting in better ventilation.

Editorial Comment

This well-designed study sets a new standard for the evaluation of perioperative pain and respiratory function after PCNL. Visual analog pain scores and analgesic requirements were markedly less in the patients receiving instillation of local anesthesia at the conclusion of the study, and this correlated well with improvements in peak expiratory flow. However, the impact on pain scores and respiratory function wore off by 24-hours postoperative, the impact on analgesic requirements were maintained for up to 24 hours.

The authors were meticulous in their technique. First, Ropivacaine was selected for its long half-life (8 hours) and high liposolubility (for the perirenal fat) and its low cardiac toxicity. Secondly, the authors instilled 10 cc in the renal parenchyma as the nephroscope was withdrawn, 15 cc in the nephrostomy tract alongside the nephrostomy tube and 5 cc at the skin incision.

Previous studies have demonstrated that less opioid utilization translates into earlier control of pain, early mobilization, improved respiratory function, shorter hospital stay and lower costs. As such, instillation of local anesthesia at the completion of PCNL should be strongly considered.

Dr. Manoj Monga

Professor, Department of Urology

University of Minnesota

Edina, Minnesota, USA

E-mail: endourol@yahoo.com