

# Contents

<b>Foreword</b>	<b>xiii</b>
-----------------	-------------

Samir S. Taneja

<b>Preface: A Vision of the Future of Stone Management</b>	<b>xv</b>
--	-----------

Ojas Shah and Brian R. Matlaga

<b>Next-Generation Fiberoptic and Digital Ureteroscopes</b>	<b>147</b>
---	------------

Etienne Xavier Keller, Vincent De Coninck, and Olivier Traxer

The versatility of ureteroscopy is attributable to tremendous technological innovations over the past decades. This article provides an overview on emerging technologies in the light of past achievements, current limitations, and possible future directions. Instrument size reduction, pressure and temperature control, active suction of stone dust, multiple-axis tip deflection, variable working channel positions, robotics, ergonomics, image quality, enhanced imaging technology, three-dimensional visualization, and the competition between reusable and single-use ureteroscopes are detailed. The twentieth century has opened an exciting path for future discoveries in ureteroscopy.

<b>Single-Use Ureteroscopes</b>	<b>165</b>
---------------------------------	------------

Brooke Moore, Silvia Proietti, Guido Giusti, and Brian H. Eisner

A PubMed search using the terms “single use” and “ureteroscope” was performed to identify published studies on this topic. In addition, the abstracts of the annual meeting of the World Congress of Endourology and the American Urologic Association since 2010 were reviewed. Here we present a review of published studies on single-use ureteroscopes.

<b>Innovations in Disposable Technologies for Stone Management</b>	<b>175</b>
--	------------

Sari S. Khaleel and Michael S. Borofsky

Disposable stone retrieval devices are an inherent element of modern-day stone management. Efforts are being made in several different areas to improve the efficiency of stone removal. Ureteral access sheaths with pressure control features as well as suction capabilities are being explored as one such mechanism. Additional efforts are being made to improve stone basket design, grasping capabilities, and deployment mechanisms. Finally, bioadhesives are being developed to potentially improve the capability to extract otherwise difficult small stone fragments and debris from the kidney.

<b>Laser Fibers for Holmium:YAG Lithotripsy: What Is Important and What Is New</b>	<b>185</b>
--	------------

Bodo E. Knudsen

Holmium:YAG laser is currently the dominant lithotripter used during retrograde intrarenal surgery. The laser energy is delivered to the target via flexible optical laser fibers. The performance characteristics of laser fibers vary. The diameter, flexibility,

resistance to fracture with bending, and tip configuration are all important factors that contribute to a fiber's overall performance. Understanding these characteristics assists the end user with proper fiber selection for procedures.

### **Emerging Laser Techniques for the Management of Stones**

**193**

Ali H. Aldoukhi, Kristian M. Black, and Khurshid R. Ghani

Next-generation holmium laser systems provide the user with a range of parameters that can help optimize fragmentation efficiency. Ureteroscopic strategies broadly consist of fragmentation with active retrieval, or dusting, which uses low pulse energy settings to break stones into fine fragments for spontaneous passage. Techniques for dusting include dancing, chipping, and popcorning. The Moses technology is a multipulse mode that may help reduce retropulsion and increase fragmentation. The thulium fiber laser is an emerging laser technology that provides an extensive parameter range for dusting. Future studies are needed to define the role of these technologies and techniques for laser lithotripsy.

### **Emerging Technologies in Ultrasonic and Pneumatic Lithotripsy**

**207**

Daniel A. Wollin and Michael E. Lipkin

Percutaneous nephrolithotomy is the treatment of choice for large renal stones. Larger, straight access tracts allow for use of rigid pneumatic and ultrasonic lithotripsy devices. Through advanced technologies, more efficient fragmentation has become possible, allowing for a variety of treatment options depending on stone location, size, and composition. As novel methods of lithotripsy enter the clinical sphere, it is a requirement that the operating urologist understand the available surgical options and the associated mechanisms used to best treat their patients. This article discusses the mechanisms of basic pneumatic and ultrasonic devices, and examines the data regarding current and novel combination lithotrites.

### **Emerging Technologies in Lithotripsy**

**215**

Tim Large and Amy E. Krambeck

This comprehensive review updates the advances in extracorporeal lithotripsy, including improvements in external shockwave lithotripsy and innovations in ultrasound based lithotripsy, such as burst wave lithotripsy, ultrasonic propulsion, and histotripsy. Advances in endoscopic technology and training have changed the surgical approach to nephrolithiasis; however, improvements and innovations in extracorporeal lithotripsy maintain its status as an excellent option in appropriately selected patients.

### **New Technologies to Aid in Percutaneous Access**

**225**

Mohammad Hajiha and D. Duane Baldwin



Video content accompanies this article at <http://www.urologic.theclinics.com>.

Although advances in percutaneous nephrolithotomy have occurred, the initial renal access remains a challenging and high-risk step. This risk and technical difficulty have resulted in a minority of urologists obtaining their own access. Therefore, continued innovation in access techniques that simplify the procedure, lower risk, and reduce radiation exposure is needed. This article provides a high-level overview

of recent advances in percutaneous renal access. The techniques are organized based on approach (antegrade or retrograde) and the imaging modality used, such as fluoroscopy, ultrasonography, computed tomography, and other novel techniques (laser, electromagnetic, and robotics).

### **Innovations in Ureteral Stent Technology**

245

Connor Forbes, Kymora B. Scotland, Dirk Lange, and Ben H. Chew

Ureteral stents are an indispensable tool in contemporary urologic patient care. They have become first-line devices for maintenance of ureteral patency postoperatively and in cases of ureteral narrowing. Despite their widespread use, these implants are associated with multiple complications including stent colic, infection, and encrustation. There is no ideal ureteric stent currently available. The aim of most recent stent innovation has been to make steps toward properties of an ideal stent. This article reviews recent technological advances in stent design and how they have attempted to tackle issues that urologists and patients face with ureteral stents.

### **New Imaging Techniques in the Management of Stone Disease**

257

Kevin Koo and Brian R. Matlaga

Recent advances in computed tomography, X-ray-based imaging, and ultrasonography have improved the accuracy of urinary stone detection and differentiation of stone composition while minimizing radiation exposure. Dual-energy computed tomography and digital tomosynthesis show promise in predicting mineral composition to optimize medical and surgical therapy. Electromagnetic tracking may enhance the use of ultrasonography to achieve percutaneous renal access for nephrolithotomy. This article reviews innovations in imaging technology in the contemporary management of urinary stone disease.

### **Radiation Mitigation Techniques in Kidney Stone Management**

265

Todd Samuel Yecies and Michelle Jo Semins

Patients with nephrolithiasis are exposed to significant quantities of ionizing radiation with the potential to cause secondary malignancy. This risk is magnified by the high recurrence rate of nephrolithiasis. In this article, we identify the risks of ionizing radiation as they pertain to patients with nephrolithiasis. We then identify evidence-based techniques for mitigating patient radiation exposure in the preoperative, intraoperative, and postoperative settings. Key factors include limiting the use of computed tomographic imaging, appropriate modulation of fluoroscopy settings, and minimizing rates of stone recurrence.

### **Innovations in Ultrasound Technology in the Management of Kidney Stones**

273

Jessica C. Dai, Michael R. Bailey, Mathew D. Sorensen, and Jonathan D. Harper

This article reviews new advances in ultrasound technology for urinary stone disease. Recent research to facilitate the diagnosis of nephrolithiasis, including use of the twinkling signal and posterior acoustic shadow, have helped to improve the use of ultrasound examination for detecting and sizing renal stones. New therapeutic applications of ultrasound technology for stone disease have emerged, including ultrasonic propulsion to reposition stones and burst wave lithotripsy to fragment stones noninvasively. The safety, efficacy, and evolution of these technologies in

phantom, animal, and human studies are reviewed herein. New developments in these rapidly growing areas of ultrasound research are also highlighted.

### **Emerging Mobile Platforms to Aid in Stone Management**

**287**

Alexander C. Small, Samantha L. Thorogood, Ojas Shah, and Kelly A. Healy

Nephrolithiasis is an increasingly common condition worldwide and mobile technology is revolutionizing how patients with kidney stone are being diagnosed and managed. Emerging platforms include software applications to increase adherence to stone prevention, mobile compatible hardware, online social media communities, and telemedicine. Applications and hardware specifically relevant to increasing hydration, diet modification, medication adherence, and rapid diagnosis (ie, mobile ultrasound and endoscopy) have the greatest potential to reduce stone recurrence and expedite treatment. Social media and online communities have also been rapidly adopted by patients and providers to promote education and support.

### **Assessing Cost-Effectiveness of New Technologies in Stone Management**

**303**

David B. Bayne and Thomas L. Chi

Diagnosis, treatment, and follow-up are all influential in determining the overall cost to the health care system for kidney stones. New innovations in the field of nephrolithiasis have been abundant, including disposable ureteroscopes, ultrasound-guided approaches to percutaneous nephrolithotomy, and advanced laser lithotripters. Identifying cost-effective treatment strategies encourages practitioners to be thoughtful about providing value-based high-quality care and remains an important principle in the treatment of urinary stone disease.