How did you come to develop an interest in the urological applications of laparoscopy?

Minimally invasive surgery is considered the future of surgery. It is less painful, results in less tissue damage and pain following procedure and leaves only small surgical scars. It is also more cost effective as it decreases the postoperative recovery period. These advantages make laparoscopy very appealing to both patients and surgeons. Urinary tract stone disease, cancer and congenital anomalies in children are among the major urological problems that can be managed with laparoscopy, providing the aforementioned advantages plus a higher accuracy rate.

Since the application of laparoscopy in urology is relatively new, there is a high capacity for research and innovation in this field. Moreover, its relevance to medical engineering doubles its potential, introducing new technologies for performing the surgical procedure more efficiently.

What are the key causes of kidney stones and what is the epidemiology of the disease?

Kidney stones are most common in middle age male adults, although they can occur at any age and an increasing number of women are developing them. Family and personal history are important risk factors, and dehydration, diet, living in warm climates and excessive sweating also significantly contribute to stone formation.

Associated disease and abnormalities in the kidney or body glands such as congenital obstructions in the urinary tract or any abnormalities in metabolism of acid, calcium and phosphate in the kidney or body glands will increase susceptibility, especially among children.

Your previous research has so far achieved a stone free rate of 80 per cent through laparoscopic nephrolithotomy after one session. Can this be further improved?

Absolutely. Complete staghorn stones are the most challenging stones due to their complex shape and multiple branches and segments. We will refine our stone localisation method during laparoscopy to better map the stone. Intraoperative sonography would be helpful to locate any...
Complete removal of complex renal stones is an ongoing challenge, especially when it comes to offering minimally-invasive, low-cost extraction techniques. However, Shiraz University of Medical Sciences, Iran, and company partners, have developed a technology capable of rising to the challenge.

**KIDNEY STONES ARE** a common disorder, known to affect 10-15 per cent of the world’s population. If the stone is small it may pass easily through an individual’s urinary tract, causing little to no pain or discomfort. Add a higher concentrate of substances like calcium oxalate, acid and phosphate, however, and the chance of producing a large stone with multiple branches and segments intensifies. These complex stones cause severe pain for the individual and, if left untreated, can lead to renal deterioration, kidney failure and life-threatening infections.

Optimised treatments for kidney stones, or renal calculi, vary between patients and are dependent on a range of factors, including stone location, composition and burden. The configuration of a renal stone can differ in shape and size, and the effective management of its largest variant – the staghorn renal stone – is an ongoing challenge for urologists; with the stone growth and recurrence rate as high as 50 per cent, the demand for minimally invasive procedures is rapidly increasing.

Renal stones are removed either in en bloc (in one piece) or broken up, with the fragmented pieces extracted by the urologist or passed by the individual. Removing the larger staghorn stone en bloc is preferred, it is, however, very difficult with current percutaneous renal surgery methods.

**Alireza Aminsharifi**, Associate Professor of Urology at Shiraz University of Medical Sciences, has dedicated numerous cohort studies and clinical trials to ensure effective, minimally invasive stone disease management. Recognised by the Iranian Endourology and Urolaparoscopy Society as the best Endourology fellowship graduate in Iran, Aminsharifi has largely focused on the technique, technology, and pre- and postoperative success rate of Laparoscopic Stone Surgery (LSS).

Consistent with other investigators in this field, his work has been seminal in the field of urology and during his career he has helped to propel LSS for management of large complex kidney stones from being an ‘option’ in the European Urological Association’s Guideline on urolithiasis (urinary tract stones) in 2007, to ‘highly recommended’ in 2009, to the ‘preferred treatment’ in 2013. His latest project, Laparoscopic Management in Stone Disease, highlights the effectiveness of LSS for its stone removal from one session across various types of stone disease, especially in complex circumstances.

**UNIQUE MORPHOLOGY**

The surgical management of stone disease is a challenge for urologists because of its morphometry. The primary goal is to remove the stone – in smaller pieces or as a whole – and eliminate the need for one or many follow-up procedures. However, urolithiasis (urinary tract stones) includes the development of different types of stones; renal stones can vary in size, location, make-up and burden. The staghorn renal stone, for example, has a complex morphometry, and can often branch out into several or all of the renal calyces. Because of this, a 100 per cent stone free rate after one session has rarely been achieved in standard techniques of percutaneous kidney surgery. It is possible with open surgery, but will leave the patient with a large abdominal scar and a high rate of postoperative morbidity.

Laparoscopy is generally used for the management of two types of renal stones: large stones in the kidney pelvis, and large stones that wholly or partially occupy all renal calyces. Aminsharifi reveals the key differences of this surgery and the traditional Open Stone Surgery (OSS): “LSS is the most novel form of minimally invasive surgery for stone disease and is an alternative to OSS for very large stones in the kidney. Instead of long incisions on the abdomen, we can access the kidney via three-to-four small holes (five-to-10 millimetres) on the abdomen, and after precise dissection of the kidney can remove the stone and repair the organ”. LSS therefore has a high rate of stone clearance in complex cases and low postoperative morbidity.

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**Is an interdisciplinary approach important to the success of your investigations?**

We believe that interdisciplinary research is key. Minimally invasive surgery provides us with a wide arena for both basic and clinical research. We are working on very basic issues such as the effect of this technology on the human’s immune system, tissue trauma and healing, to designing and patenting new surgical instruments and systems.
INTELLIGENCE

LAPAROSCOPIC MANAGEMENT IN STONE DISEASE

OBJECTIVES

To offer laparoscopy as an alternative minimally invasive surgical procedure for management of large complex kidney stones.

KEY COLLABORATORS

Professor Abdolaziz Khezri, Head of Department of Urology; Dr Mohammad M Hosseini, Director of endourology unit, Shiraz University of Medical Sciences • Professor Nasser Simforoosh, Head of Department of Urology, Shahid Beheshti University of Medical Sciences, Tehran • Professor Abbas Basiri, President, Iranian Endourology and Urolaparoscopy Society (IEUS)

FUNDING

Shiraz University of Medical Sciences supported laparoscopic stone surgery-related research • The current publication was sponsored by Fanavari Azmayeshgahi, the Iranian distributor of Olympus

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ALIREZA AMINSHARIFI is Dean of the Department of Urology at Shiraz University of Medical Sciences (SUMS) and a subspecialist in minimally invasive urologic surgery. He has particular expertise in the surgical management of urology, especially endourology and laparoscopy, accident and emergency, stone disease, cancer patients and paediatric urology. Aminsharifi received his MD at SUMS. He has received several awards including: Best Endourology Fellowship Graduate in Iran, Iranian Endourology and Urolaparoscopy Society (IEUS,2012); Iranian President Award (3rd top researcher in the field of surgery, nationwide, 2013); and Best Young Urologist in Iran, Avicenna Prize Iranian Urological Association (IUA, 2014).

Less invasive extraction methods than LSS are also available to kidney stone patients, but have not proven to be the most effective or efficient treatment modalities for staghorn renal stones. Shock Wave Lithotripsy (SWL), for example, is an extracorporeal procedure that uses pressure waves targeted at the kidney, causing the stone to fragment into tiny pieces. The procedure is generally reserved for stones less than 2 cm in diameter. Other percutaneous-endoscopic extraction methods again fall short when it comes to the larger renal stones because they open the possibility for remnants to be left behind. “Routine minimally invasive methods might have a limited efficacy for their management and several sessions of operation may be needed for complete stone clearance,” explains Aminsharifi. “This, in turn, might result in considerable complications and treatment cost.”

PUTTING THE CASE FORWARD

Aminsharifi’s project builds on the benefits and success rate of LSS demonstrated in a number of his earlier studies. In 2008 he and his team demonstrated the feasibility of laparoscopic removal of staghorn stones for the first time, thus offering an alternative minimally invasive approach for similar complex cases. By 2013 this study represented the largest series of its kind worldwide and, since then, many researchers have become aware of this novel technique.

In a recent trial, Aminsharifi and his team performed laparoscopic extraction of complete staghorn kidney stones on 10 patients that bought forth very promising results. They achieved an 80 per cent success rate removing stones in their entirety after one surgical session. Furthermore, the procedure itself had significant postoperative effects: “The involved kidney of all of these patients remained completely functional after laparoscopic extraction of the stone from kidney with a significant improvement in obstruction one year after their operation,” adds Aminsharifi.

In a subsequent trial, Aminsharifi compared laparoscopy with the standard percutaneous techniques. The outcomes of the two techniques were compared for the management of 60 patients with a mean renal pelvis stone of 35 mm. The result of the study was clear: “We found that not only was the one-session stone clearance rate higher in laparoscopy (100 per cent versus 76.6 per cent), but 23.3 per cent of patients in the percutaneous stone removal group required at least one ancillary procedure to become stone free,” confirms Aminsharifi. In consequence, this led to a significantly lower overall cost for the laparoscopy group (US $683.90 versus $815.90). Interestingly, he added: “The hospital stay, the need for blood transfusion and the convalescence period were similar between the two groups”.

Renal stones can cause significant damage to individuals, especially when variants like the staghorn stone are left untreated, or not managed with care and caution. Historically, removing these large stones has been a costly, complex and suboptimal procedure. It is for this reason that laparoscopy is becoming increasingly prevalent in urology to tackle one of the field’s most challenging tasks – the safe, complete and en bloc removal of staghorn and large stones using a minimally invasive method.

Aminsharifi’s project sits at the forefront of laparoscopic developments and its associated state-of-the-art technology. Moreover, he is pushing the knowledge and benefits gained back into the field of urology through student fellowship programmes and out into the community of patients through timely treatment. “Education and research are cornerstone missions of our centre,” concludes Aminsharifi. “We have many different training programmes from short visits to hands-on clinical courses as well as student exchange programmes for national and international applicants.”