Today I would like to present two exciting areas of endourology that are likely to have a significant role to play in our surgical armamentarium in the near future: percutaneous endopyeloplasty for treatment of primary ureteropelvic junction obstruction and robotic-assisted flexible ureteroscopy for treatment of small to medium sized renal calculi.

Primary UPJO is the commonest congenital condition affecting the kidney present in 1 of 400 live births. Many of these patients are currently diagnosed before birth due to routine use of prenatal ultrasound.

The surgical treatment of primary UPJO in the adult and older child has revolved around endopyelotomy and pyeloplasty. Endopyelotomy, which consists of creating a full thickness incision across the stricture segment, though the least invasive procedure, in our experience, has a 30% failure rate over a 4 year follow up. Pyeloplasty, which involves excision and refashioning of the ureteropelvic junction has a higher success rate but is more invasive endopyelotomy.

Percutaneous endopyeloplasty is a novel technique that was developed and refined by our team at Cleveland Clinic that aims to combine the simplicity of an endopyelotomy with the success of pyeloplasty in the appropriate patient. Endopyeloplasty consists of horizontal suturing of a vertical endopyelotomy incision using 2-3 interrupted sutures performed percutaneously via a nephroscope.

The suturing is performed with the use of a novel suturing device: the Sewright SR5 manufactured by LSI Solutions.

The first step consists of obtaining percutaneous access through an appropriate upper or mid pole calyx.

Subsequently a full thickness endopyelotomy incision is made across the stricture segment.

The next step consists of mobilizing the distal ureteral margin with the use of a 2 mm laparoscopic Endoshears to create adequate space and mobilization for subsequent suturing.

Finally, the endopyelotomy incision is sutured using 2-4 interrupted 2- Vikryl sutures with the aid of the Sewright suturing device as shown in the illustration. This achieves precise mucosa-to-mucosa coaptation.

Our detailed animal study published in the Journal of Endourology showed that percutaneous endopyeloplasty caused significantly less urine extravasation and was associated with a significantly wider caliber compared with endopyelotomy.

This picture of a harvested kidney from our animal study shows a well-healed scar after endopyeloplasty. We believe that the absence of urinary extravasation and primary intention healing allows for an optimal milieu for ureteral healing.

Subsequently, we published our initial clinical experience on 9 patients with primary UPJO. Our selection criteria for endopyeloplasty includes a patient with a short segment obstruction, moderate to mild hydronephrosis and good renal function and absence of a crossing vessel.
We recently analyzed our data on 51 patients that have undergone this procedure with 1 failure till date over a mean follow up of 13 months.

This x-ray shows pre and 1 year postoperative IVP films of a patient having undergone a successful endopyeloplasty.

More recently we have just completed and published an animal experiment with completely dismembered endopyeloplasty, wherein the entire UPJ is dismembered and reconstructed, similar to a payeloplasty. This may potentially extend the scope of this procedure to patients with severe hydronephrosis, poor renal function and crossing vessel. However, much greater refinement of the dismembered endopyeloplasty needs to be done prior to clinical application. Thus, to conclude, percutaneous endopyeloplasty is a promising technique. We await more data with longer followup from multiple institutions to validate these encouraging initial results.

Flexible ureteroscopy is being increasingly applied for treatment of small to medium sized renal calculi. Availability of actively deflectable flexible endoscopes and accessories such as nitinol baskets and holmium laser has enabled the increasing application of flexible ureteroscopy for renal calculi.

Current flexible ureteroscopy has certain limitations. The available ureteroscopes only have uniplanar active deflection. Other movements such as rotational torque and insertion and retraction are transmitted manually from the outside through the length of the instrument making it suboptimal. Flexible ureteroscopy is not very ergonomic and the surgeon is exposed to the radiation source.

At Cleveland Clinic our team has worked on a flexible robotic catheter control system by Hansen Medical for use to perform flexible ureteroscopy in the animal model. The current system designed for intracardiac use was modified in terms of catheter configuration and software for ureteroscopic use.

The robotic catheter system has instinctive control via a joystick. The tip of the sheath can be positioned at anytime in space by control of the 3D joystick called the master input device.

We used the robotic system for performing ureteroscopic procedures in 6 animals after approval from IACUC. The objectives were to assess the feasibility to insert the somewhat large 14 Fr catheter sheath, to assess the ability and reproducibility of intrarenal navigation and the ability to perform intrarenal maneuvers such as laser lithotripsy for stones and papillary ablation using the Holmium laser and to check the stability of the tip in the collecting system.

The procedure consisted of manual insertion of the sheath under fluoroscopic control over a guide-wire. Subsequently, a custom made passive fiberscope was inserted through the sheath and connected to an endovision camera.

We were able to insert the sheath in all 10 kidneys assessed. 83 of the possible 85 calices were accessed using robotic control. The time decreased with experience and all calices in the last kidney could be inspected in 45 seconds. There was 1 minor perforation. Fluid extravasation was found in our initial experiment. However, this problem has been solved by reducing the size of the passive ureteroscope allowing for a greater lumen for fluid outflow.
To conclude, the robotic system has some potential advantages for ureteroscopic application. We feel it has an increased ease of maneuverability, increased degrees of freedom, stability, allows for surgical automation, incorporates and integrates various imaging modalities, is ergonomically superior and removes the surgeon from the radiation field. Further studies and clinical trials are needed to better define its scope in clinical practice.