Use of indocyanine green for ureteric illumination and visualization

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The ureters arise from the renal pelvis and track towards the bladder in close proximity to important vascular structures (aorta and inferior vena cava; common, external and internal iliac vessels), and pelvic organs, which make it vulnerable to intra-operative injury. The risk of ureteric injury at laparoscopic hysterectomy is approximately 0.5%, but can vary depending on risk factors.1

The distal (pelvic) part of the ureter is most exposed to iatrogenic injury. Risk of injury increases with complexity of the planned surgical procedure, distorted anatomy, and surgical technique/skill (eg, learning curve during robotic surgery). Injuries occur through the surgeon being unaware of the proximity of the ureter(s), which may lead to intra-operative misjudgment.

Video 1  Use of ICG for intra-operative ureteric illumination at laparoscopic hysterectomy
under pre-clinical development. A practical solution is the intra-operative injection of indocyanine green (ICG) into the ureter through a cystoscopy (retrograde) approach.

ICG is prepared for injection in a 10 mL syringe. A normal saline cystoscopy is performed with a secondary laparoscopic stack allowing simultaneous laparoscopic and cystoscopic views. Bladder intactness is checked, both ureteric orifices are located, ureteric catheters (7 French) are inserted over a guidewire 5 to 10 cm into one or both ureters, and ICG is injected (5 mL each side). The ureteric catheter(s) is removed and an indwelling catheter is placed. At laparoscopy, the injected ureter is visualized immediately (see Online Supplemental File 1).

Our video article demonstrates the use of ICG in a patient who underwent a laparoscopic hysterectomy, 5 years following a radical trachelectomy for stage IB1 cervical adenosquamous carcinoma previously. The retroperitoneum was highly distorted and white light laparoscopic surgical assessment failed to identify the ureters.

This technique has been described in laparoscopic, colorectal surgery, and gynecological surgery. This article demonstrates the use of this technique in the setting of distorted anatomy and significant adhesions.

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Patient consent for publication Consent obtained directly from patient(s)

Ethics approval This study involves human participants. In keeping with other major ethics committees, the institutions of the authors do not require formal ethics approval for case reports, where explicit patient consent is provided, as in this case. The study participant gave written informed consent to produce a video for teaching, medical education, research and publication on- and offline.

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REFERENCES
**Supplementary Material**

Specific materials needed

- ICG: 20 mL of sterile water, 25 mg of lyophilized ICG, to create 1.25 mg/mL concentration
- Cystoscopy (with normal saline)
- Indwelling catheter
- Two laparoscopic systems: one for cystoscopy and another for laparoscopy (white light and Near Infrared Imaging)

Summary of tips for carrying out the procedure

- ICG is prepared for injection. In brief, 20 mL of sterile water is mixed with 25 mg of lyophilized ICG creating a 1.25 mg/mL concentration. We draw up 5mL of the ICG mixture into a 5mL syringe
- A cystoscopy with normal saline is performed. The bladder is checked for intactness and both ureteric orifices are located. The surgeon advances a ureteric catheter (e.g., 7FR) over a guidewire 10cm to 15cm cephalad into both ureters and injects the ICG (5ml each side). The ureteric catheter is removed and an indwelling catheter is placed
- We use two laparoscopic systems: One for cystoscopy and another for laparoscopy so that the injected ureter can be visualised immediately through near infrared medical imaging