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CASE REPORT

ICG-guided intracorporeal intestinal diversion with the Hugo™ RAS system following radical cystectomy: technological background and case report

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Background: *Robotic radical cystectomy has demonstrated non-inferiority compared with the open approach; however, bowel and uretero-enteric anastomoses remain challenging and prone to complications. Indocyanine Green (ICG) is a fluorescent dye that emits near-infrared light after intravenous administration and enhances the evaluation of tissue perfusion, lymphatic mapping, and anatomical delineation. By allowing real-time assessment of tissue viability, ICG may reduce the risk of anastomotic leakage and ischemic complications. ICG fluorescence was first integrated into the Da Vinci system through Firefly technology, while the Hugo™ Robotic-Assisted Surgery (RAS) platform initially lacked ICG compatibility. We report a preliminary urological application of the recently developed Rubina® ICG fluorescence system integrated with Hugo™ RAS for intracorporeal intestinal diversion following radical cystectomy.*

Case Description: *A 72-year-old male patient with a BMI of 32 was eligible for robotic-assisted radical cystectomy with intracorporeal ileal conduit using the Hugo™ RAS platform. Rubina® with ICG was employed to assess real-time perfusion of the mesentery, ureters, and anastomosis, confirming adequate vascularization. The combined use of Rubina® on Hugo™ provided clear and versatile imaging, potentially reducing anastomotic complications. Postoperative recovery was uneventful, with no complications or readmissions, and normal renal function was observed at 4 months follow-up.*

Conclusions: *This case represents a successful use of the Rubina® ICG fluorescence system integrated with Hugo™ RAS for intracorporeal intestinal diversion after radical cystectomy. ICG fluorescence enables real-time perfusion assessment, potentially reducing anastomotic complications. This experience expands the capabilities of the Hugo™ platform and supports the role of fluorescence-guided robotic surgery in complex urologic procedures.*

Key Words: bladder cancer, robotic surgery, radical cystectomy, robotic systems, case report

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Introduction

Radical cystectomy is the treatment of choice for muscle-invasive or very high-risk non-muscle-invasive bladder cancer. The robotic approach proved its non-inferiority in terms of oncological outcomes with possible advantages in terms of peri-operative results.[1] However, the reconstruction of an ileal urinary diversion still represents a challenging step. Bowel manipulation and uretero-enteric anastomosis may be prone to complications such as leakage, ischemia, and late stenosis, and controversies exist regarding the best surgical approach as far as uretero-enteric anastomosis is concerned.[1–3] Although indocyanine Green (ICG) has become widely adopted to support real-time vascular evaluation during robotic reconstruction, its integration across different robotic platforms has not been uniform.

This case describes one of the first intracorporeal urinary diversions performed on the Hugo™ Robotic-Assisted Surgery (RAS) system after the introduction of the integrated Rubina® fluorescence technology. Unlike earlier experiences that required an additional laparoscopic camera for ICG imaging[4], this case demonstrates how native NIR fluorescence can be seamlessly incorporated into the workflow, potentially improving the safety and reproducibility of uretero-enteric anastomosis. The report offers practical insights into the perioperative application, advantages, and technical nuances of ICG-guided reconstruction on this emerging robotic platform.

Case Report

Patient information

We report the first urological application of Rubina® in a robotic setting, specifically a RARC with intracorporeal ileal conduit urinary diversion using the Hugo™ RAS platform. A 72-year-old man patient, with a body mass index of 32 (weight 95 kg, height 170 cm), and a medical history significant for arterial hypertension and smoking cessation, was initially diagnosed in 2001 with non-muscle invasive bladder cancer (NMIBC). Over the years, he experienced multiple tumor recurrences that were managed with intravesical therapies. In August 2024, the patient presented with tumor recurrence characterized by a large (approximately 4 cm), partly solid and papillomatous bladder tumor. During transurethral resection, the left ureteral orifice was not visualized. Histopathological analysis confirmed a diagnosis of high-grade papillary urothelial carcinoma (HG G3 T2). He subsequently underwent four cycles of neoadjuvant chemotherapy with cisplatin and gemcitabine, completed in January 2025, and in April 2025, he underwent a robotic-assisted radical cystectomy with intracorporeal ileal conduit urinary diversion (Bricker procedure).

Clinically, the patient denied significant lower urinary tract symptoms, recent episodes of gross hematuria, and bilateral colicky lumbar pain. No metastatic sites were evident at pre-op contrast CT scan.

The procedure was performed at the Gemelli Hospital in Rome; the patient signed an informed consent to the procedure (Hugo RAS cystectomy with all related technologies required during surgery), and an Institution's Ethics Committee-approved (Territorial Ethic Committee Lazio Area 3) form of agreement for clinical, video, and imaging data collection (approval number: 5119/2022) was obtained. Case reporting adhered to the CARE Checklist (Supplementary Material S1).

Surgical procedure

The patient is positioned in an 18° Trendelenburg tilt. The procedure begins with the identification and careful dissection of both ureters, starting above the iliac vessels and continuing down to their entry into the bladder. At the bladder level, each ureter is sealed with a medium-sized Hem-o-lok clip and then divided. The peritoneum is incised at the level of the seminal vesicles, and the dissection proceeds in the plane between Denonvilliers' fascia and the posterior surface of the prostate. Both lateral sides of the bladder are mobilized, with the bladder pedicles being clipped and transected.

Overall, to aid exposure, especially in cases with significant tumor load, the fourth robotic arm is used to elevate the bladder, which is critical for optimal visualization and control; in male patients, the neurovascular bundles are preserved when clinically appropriate. An inverted U-shaped peritonectomy is performed between the internal inguinal rings, and the umbilical arteries are divided. This allows entry into the space of Retzius. The anterior bladder wall is then dissected free, and the Santorini plexus is ligated and sutured.

The urethra is isolated and then transected after placement of a large Hem-o-lok clip to minimize urinary leakage. The urethral stump is retained for as long as feasible. Intraoperative frozen sections are taken from the distal ureters and urethral margin, while an extended bilateral pelvic lymph node dissection is simultaneously carried out.

After laparoscopic isolation and division of a 15 cm ileal segment to form the conduit, an ileo-ileal

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anastomosis was created using the Signia™ stapling system (60 mm cutline; Medtronic, Minneapolis, MN, USA). ICG was administered in 3 mL boluses (0.2 mg/kg); following the injection of indocyanine green, the near-infrared mode was activated using a foot pedal at the surgical console. The Rubina® system (KARL STORZ, Tuttlingen, Germany) offers three visualization modes, all of which were tested. The Overlay mode displays tissue perfusion in green or blue hues, depending on the surgeon's choice. The Intensity Map mode represents fluorescence on a color scale from blue to yellow, indicating the level of perfusion. The Monochromatic mode uses a white signal on a black background, enhancing image clarity through high contrast. These modes can be activated either through the console menu or with a simple press of the optical pedal, making the process fast and user-friendly. All three modes confirmed good blood flow at the surgical site in the reported case. Notably, the Intensity Map mode allows semi-quantitative, real-time assessment of tissue perfusion. The combined use of the Rubina® system with the Hugo™ RAS robotic platform (Medtronic, Minneapolis, MN, USA) offered clear, interpretable imaging that can help reduce the risk of anastomotic leaks and improve surgical outcomes. While other robotic platforms also offer ICG technology, they typically provide only a single visualization mode, limiting the depth of perfusion analysis compared to the versatile Rubina® system.

In this case, this facilitated the confirmation of mesenteric perfusion, of distal ureteral vascularization (in a Wallace I ureteroenteric anastomosis), and anastomotic viability (Figures 1 and 2). A video demonstration of the procedure is available at https://drive.google.com/file/d/1FX7RFAvYUF8sorpzKNzsGiLouX8iagTh/view?usp= sharing.

Follow-up

The intervention was adequately tolerated; postoperative recovery was uneventful; the first flatus occurred on postoperative (PO) day 1, together with patient mobilization. Bowel canalization was achieved on PO day 3, and ureteral stents were removed on postoperative day 12; thereafter, the patient was discharged. No intraoperative or postoperative complications were reported, nor did 30- and 90-day re-admission occur. Histology confirmed a high-grade non-muscle invasive bladder cancer. Four months after surgery, the patient showed normal GFR with the absence of hydronephrosis.

FIGURE 1. Latero-lateral intestinal anastomosis with Signia and use of indocyanine Green (ICG) to check vascular perfusion (overview modality, superimposition of green to the surgical field)

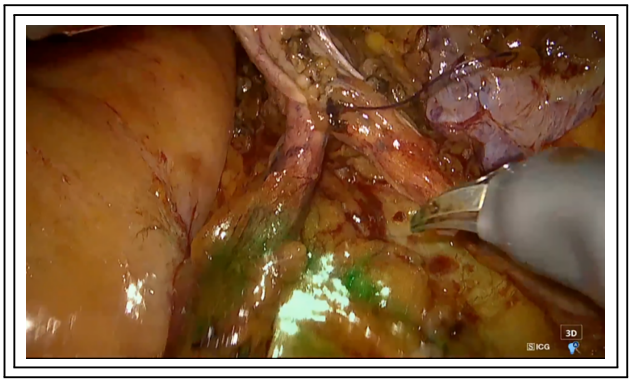

FIGURE 2. Ureteral perfusion was checked at the time of Wallace anastomosis (overview modality, superimposition of green to the surgical field)

Discussion

In urology, the application of ICG has expanded significantly, particularly in minimally invasive and robotic procedures. During partial nephrectomy, for instance, ICG facilitates precise identification of tumor margins, improves visualization of renal vasculature, and allows for selective clamping of segmental arteries to minimize ischemia and preserve renal function.[5] Additionally, fluorescence-guided imaging aids in differentiating tumors from normal parenchyma, contributing to oncologic precision and nephron-sparing outcomes.

In gastrointestinal and colorectal surgery, ICG enables real-time visualization of tissue viability and perfusion, especially during anastomosis creation. Its use has been associated with a reduction in anastomotic leaks and ischemic complications. A growing

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body of evidence supports ICG-guided perfusion assessment as a standard adjunct in complex abdominal procedures, including those involving bowel resections and reconstructions.

In the context of robotic-assisted urologic oncology, the role of ICG has been further underscored in the setting of intracorporeal urinary diversions (ICUD) following robotic-assisted radical cystectomy (RARC) for muscle-invasive and high-risk non-muscle-invasive bladder cancer. The integration of ICG into robotic platforms has enabled real-time perfusion analysis during ileal conduit or neobladder formation, thereby improving the safety profile of these complex procedures.

Initially, ICG was used with the Da Vinci Surgical System for intraoperative mesenteric angiography.[6] Its integration through the Firefly™ fluorescence imaging technology, specifically on the Da Vinci Xi platform, marked a major advance. Firefly enables dynamic NIR visualization during surgery, providing surgeons with enhanced information about bowel perfusion, ureteral vascularization, and mesenteric viability. Clinical data have demonstrated its benefits.[6–8]

Manny and Hemal[6] in 2014 reported on 8 patients with localized high-grade bladder cancer who underwent fluorescence-enhanced robotic radical cystectomy and received an intracorporeal ileal conduit urinary diversion. In those cases, a 2 mL intravenous dose of ICG was administered to perform mesenteric angiography. This technique helped preserve vascular supply to both the conduit and the remaining bowel. Mesenteric angiography was successful in all 8 patients who underwent diversion, with bowel vasculature identified in under a minute following ICG injection, allowing precise visualization of mesenteric arcades prior to bowel stapling.

More recently, in the retrospective study by Fu et al.,[8] outcomes were analyzed in 238 patients who underwent robot-assisted cystectomy with or without ICG between 2012 and 2021. Patients were grouped based on whether ICG was used intraoperatively. The ICG group (138 patients) had a higher rate of intracorporeal urinary diversions and simple cystectomies compared to the non-ICG group (100 patients). Notably, patients who received ICG resumed oral intake sooner (4.9 vs. 7.1 days) and had a shorter hospital stay (8.3 vs. 12.8 days), both statistically significant findings. Although the incidence of postoperative ileus was similar between groups, none of the ICG patients experienced a bowel leak, whereas five leaks occurred in the non-ICG group—a significant difference. These results suggested that ICG use during RAC and intracorporeal urinary diversion may improve surgical outcomes, particularly by reducing the risk of anastomotic leaks and shortening recovery time.

To our knowledge, we present the first documented case of Rubina®-enhanced fluorescence imaging in a RARC with intestinal diversion with Hugo™ RAS. In general surgery, a prior case was published from our Institution:[9] a fully robotic right hemicolectomy was carried out on a male patient diagnosed with cecal cancer, utilizing the Hugo™ RAS surgical system. To evaluate blood flow, indocyanine green fluorescence imaging was employed to assess perfusion of the ileal and colic stumps both prior to and following the ileocolic anastomosis. The system proved to be user-friendly, effective, and safe, without increasing operative time or complexity. As far as a comparison with the ICG on the Da Vinci is concerned, the latter requires an activation made on the touchpad and on the surgeon console and a switching between normal white light and fluorescence imaging; the Hugo™ RAS allows for different modes of visualization—including an Overlay Mode and a semi-quantitative evaluation of tissue perfusion via the Intensity Map mode—that are all summarized in Table 1.

This case presents several strengths and limitations that must be acknowledged. One strength lies in the novelty of applying native Rubina® fluoroscence within the Hugo™ RAS platform during intracorporeal urinary diversion, offering early practical insight into how real-time perfusion assessment can be integrated into a workflow previously limited by the absence of built-in NIR imaging. The case contributes to the growing experience with this new robotic system and provides technical details that may support other centers beginning to adopt this platform.

Nevertheless, important limitations remain. As a single-case experience, the findings cannot be generalized or used to infer superiority over other fluorescence technologies or robotic systems. The lack of a comparative group prevents conclusions regarding whether the integrated fluorescence directly influenced outcomes. Intraoperative fluorescence assessment, although useful, is inherently subjective and operator-dependent, and the semi-quantitative Intensity Map function requires validation in prospective studies. Moreover, long-term follow-up is limited, and the case cannot provide definitive information on late complications such as ureteroenteric stricture formation. Finally, the procedure was conducted in a high-volume, experienced center, which may limit

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TABLE 1. **Summary of the features of the Rubina® technology, which provides a combination of near-infrared (NIR) fluorescence with advanced image enhancement features**

Features Mode	Description	Purpose/Benefit
Overlay mode	Shows perfusion information overlaid on the standard surgical image (color scale/interface: green or blue according to the surgeon's preference)	Visualizes tissue perfusion while retaining anatomical detail
Intensity map mode	Displays a fluorescence-based heatmap to assess perfusion intensity (blue to yellow, increasing fluorescence)	Enables comparative evaluation of tissue perfusion
Monochromatic mode	Shows only the ICG signal in high-contrast format (white on black)	Enhances signal clarity with strong contrast; ideal for precise visualization
Indocyanine Green (ICG) activation	ICG mode can be activated from the console menu or via a foot (optical) pedal	Provides flexibility in activation method; hands-free option via pedal
Workflow integration	Activation and deactivation are fast, simple, and intuitive. Seamlessly fits into surgical flow	Enhances efficiency; potential to minimize discontinuation of surgical rhythm

the reproducibility of the workflow and outcomes in lower-volume settings.

Conclusions

In conclusion, Rubina®'s compatibility with the modular Hugo™ RAS platform may be considered a promising new tool for urologic surgeons, allowing for better visualization during complex reconstructions; further clinical studies involving larger patient cohorts are warranted to validate these findings and to assess long-term outcomes. Moreover, the potential of Rubina® technology may extend to other urologic procedures such as robotic partial nephrectomy, lymphadenectomy, and adrenalectomy, where intraoperative perfusion assessment could offer significant benefits.

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Author Contributions

Supervision: Angelo Totaro, Enrico Panio, FIlippo Turri, Nazario Foschi, Maria Chiara Sighinolfi, Giovanni Panico, Anna Fagotti, Bernardo Rocco. Data collection: Simone Assumma, Enrico Panio, Filippo Gavi, Simona Presutti, Pierluigi Russo. Writing and editing: Maria Chiara Sighinolfi, Filippo Gavi, Pierluigi Russo. All authors reviewed and approved the final version of the manuscript.

Availability of Data and Materials

Internal database upon request.

Ethical Approval

This ethical approval and consent form was approved under the protocol number: 5119/2022, by Gemelli Hospital, Territorial Ethic Committee Lazio Area 3. The patient signed an informed consent to the procedure.

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Conflicts of Interest

The authors declare no conflict of interest.

Supplementary Materials

The supplementary material is available online at https://www.techscience.com/doi/10.32604/cju.2026.067267/s1.

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