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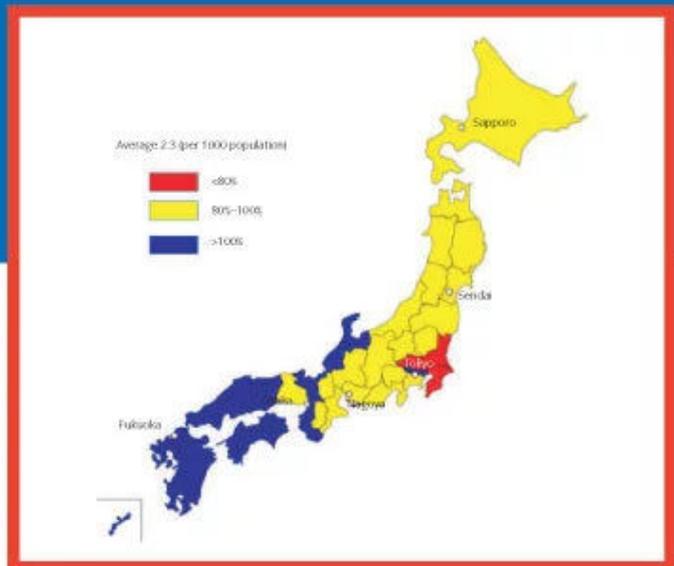


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The density of physicians in each Japanese prefecture in 2014 compared to the national average of 100 (pp. 327–336).

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international centers have invested in long-term development of conservative UTUC management expertise.

The publication of our first experience with thulium:YAG laser in 2011³ has been updated recently by a long-term single center 10-year review,⁴ which will report our experience on oncological safety and efficacy for conservative UTUC management. This should provide the rationale for more renal sparing in lower-risk UTUC using the thulium:YAG laser henceforth, as well as incorporation of this modality into future international guidelines.

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Conflict of interest

None declared.

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Feasibility of utilizing near-infrared fluorescence imaging with indocyanine green for super-selective arterial clamping in pure laparoscopic partial nephrectomy

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Abbreviations & Acronyms

ICG = indocyanin green
LPN = laparoscopic partial nephrectomy
NIRF = near-infrared fluorescence
PN = partial nephrectomy

An ideal PN has been suggested to require a “trifecta” of negative resection margins, the absence of surgical complications and a minimal decrease in function of the renal remnant.¹ There is growing interest in tumor-specific clamping of renal artery branches to facilitate minimal ischemia of the remnant parenchyma, as warm ischemia time appears to be significantly associated with postoperative renal outcome.²

ICG is a fluorescent tracer that has been used together with NIRF imaging for visualization of renal perfusion.³ There is increasing evidence supporting its use in Firefly fluorescence imaging for the da Vinci Si Surgical System to assist in super-selective clamping of renal artery branches.^{4,5} Nevertheless, this technology is expensive, and evidence in robotic PN is limited, while data regarding its use in pure LPN are even more scarce. We adapted the use of ICG in NIRF imaging to facilitate super-selective clamping in a series of pure LPN, and describe our surgical technique, and operative and early postoperative outcomes for the cases involved.

A total of 35 cases of pure LPN with NIRF imaging in three tertiary centers (Eberhard Karls University Medical Hospital of Tuebingen, Germany; Dnepropetrovsk State Medical Academy, Ukraine; Singapore General Hospital, Singapore) were carried out between January 2016 and January 2017. All LPN procedures were carried out with the Image1 S Near-Infrared System (Karl Storz, Tuttlingen, Germany), through the transperitoneal approach. Tumor exposure, hilar dissection and clamping, and preparation of the tumor for excision were carried out as previously described.⁶ Careful dissection of the renal hilar fat for exposure of renal artery branches was carried out, and branches supplying the tumor and surrounding parenchyma were identified and correlated to preoperative imaging before bulldog clamps (Aesculap, Center Valley, PA, USA) were applied (Fig. 1a). The tumor was delineated intraoperatively with ultrasound, and margins marked with diathermy before super-selective clamping.

ICG (Pulsion Medical Systems AG, Munich, Germany) was prepared as a 2.5-mg/mL solution before every case. A bolus dose of 0.4 mg/kg was given by the anesthetist after the specific renal artery branch was clamped. In all cases, only one bolus of ICG was required to obtain acceptable fluorescence for visualization of the renal vasculature, and the recommended maximum dose of 2 mg/kg was not exceeded. Patients were monitored closely during and after administration of ICG for adverse reactions. On administration of ICG, the camera view was momentarily switched to NIRF to visualize uptake of ICG. Well-perfused renal parenchyma fluoresced blue-green under NIRF, while the ischemic tumor and adjacent renal parenchyma did not fluoresce (Fig. 1b,c), providing confirmation that the tumor-specific arterial branch was controlled. If the tumor continued to show uptake of fluorescent ICG

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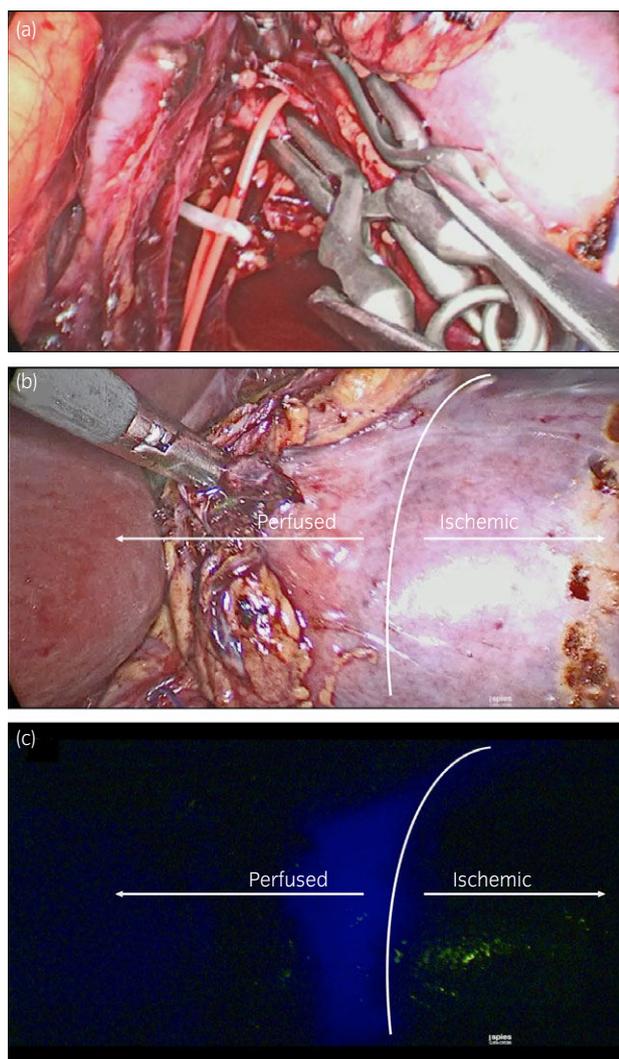


Fig. 1 (a) Selective application of bulldog clamps on renal artery branches supplying the tumor. The tumor was visualized after clamping the artery in (b) white light and (c) under NIRF imaging. Areas of fluorescence suggesting perfusion are differentiated from ischemic areas.

despite super-selective clamping, the main renal artery was clamped instead as per the conventional PN approach. The tumor was then excised along a previously scored margin with cold-cut scissors, followed by renorrhaphy.

Perioperative information is summarized in Table S1. Of all 35 pure LPN cases, successful minimally ischemic PN with super-selective clamping of renal artery was achieved in 23 (65.7%) patients. In eight patients, persistent fluorescence of the tumor suggesting perfusion was seen on NIRF and main renal artery clamping was carried out. Parenchymal bleeding obscuring vision occurred in four patients after excision, necessitating clamping of the main artery as well. The median operating time for all cases was 141 min (range 80–395 min), and the median estimated blood loss was 200 mL (range 40–1250 mL). For all 12 cases undergoing conventional PN, the median warm ischemic time was 17 min (range 6–23 min). The percentage loss in the estimated glomerular filtration rate

on 1-month follow up was -3.1% . On final histology, 25 of the 35 lesions were found to be malignant, with 20 clear cell renal cell carcinomas and five papillary renal cell carcinomas. Among the malignant tumors, eight were Fuhrman grade 1, 15 were grade 2 and two were grade 3. There were no cases of positive surgical margins on final histology.

We believe that NIRF imaging with ICG does have a role as an adjunct imaging technique in LPN. Robotic surgery is still not available in several parts of the world, and the feasibility of NIRF imaging with LPN allows for a useful adjunct to pure laparoscopic surgeons carrying out PN. In direct comparison with robotic surgery, this technique offers a more cost-effective alternative, with robotic PN on average being priced US\$1500 more than LPN.⁷

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Conflict of interest

None declared.

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Supporting information

Additional Supporting Information may be found in the online version of this article at the publisher’s web-site:

Table S1. Operative characteristics and post-operative outcomes for patients undergoing pure laparoscopic partial nephrectomy with super-selective arterial clamping assisted by NIRF imaging.