

Indocyanine green angiography and lymphography in microsurgical subinguinal varicocelectomy with evolving video microsurgery and fluorescence imaging platforms

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Intra-operative use of indocyanine green (ICG) angiography and lymphography has been reported as a valuable adjunct during microsurgical subinguinal varicocelectomy (MSV).¹ The development of a video microsurgery platform and fluorescence imaging technology further facilitates identification of testicular arteries and lymphatics. We report the intra-operative imaging of two patients who underwent varicocele repair for grade 3 left varicoceles in February and March 2021 using the new platform.

The operations were performed under three-dimensional (3D) optical magnification images on the television monitors using the video microsurgery platform with VITOM® 3D system (KARL STORZ SE, Tuttlingen, Germany) as previously described.² A pack of 25 mg ICG (Diagnogreen; Daiichi Sankyo Co, Tokyo, Japan) was dissolved in 10 mL water. Identification of testicular arteries was assisted by ICG angiography with intravenous injection of 2 mL (5 mg) ICG solution. After preservation of the testicular arteries, the differentiation between lymphatics and small veins was facilitated by ICG lymphography performed following intra-parenchymal testicular injection of 0.5 mL (1.25 mg) ICG solution followed by gentle testicular massage.³

The setting of ICG fluorescence imaging consisted of an IMAGE1 S™ 4U RUBINA™ with 4K 3D monitor system (KARL STORZ SE, Tuttlingen, Germany) and a HOPKINS™ Straight Forward Telescope 0° (10-mm diameter/20-cm length) [KARL STORZ SE, Tuttlingen, Germany]. We demonstrate intra-operative ICG angiography of patient 1, a 35-year-old man with primary infertility and oligoasthenoteratozoospermia. The testicular artery appeared green on the overlay image mode with clear simultaneous visualisation of white light microscopy images in the background (Fig 1a and b). In addition to the testicular artery, the small (<1 mm) cremasteric artery could also be identified in the monochromatic mode that further enhanced the contrast (Fig 1c). After successful preservation of the testicular arteries in patient 2, a 28-year-old man with left scrotal pain, two probable lymphatics were identified under white light microscopy (Fig 2a). The strong green colouration seen in the overlay mode after ICG injection unambiguously confirmed the successful preservation of lymphatics in MSV (Fig 2b).

Microsurgical subinguinal varicocelectomy is the standard for varicocele repair with excellent surgical outcomes reported.⁴ Nonetheless

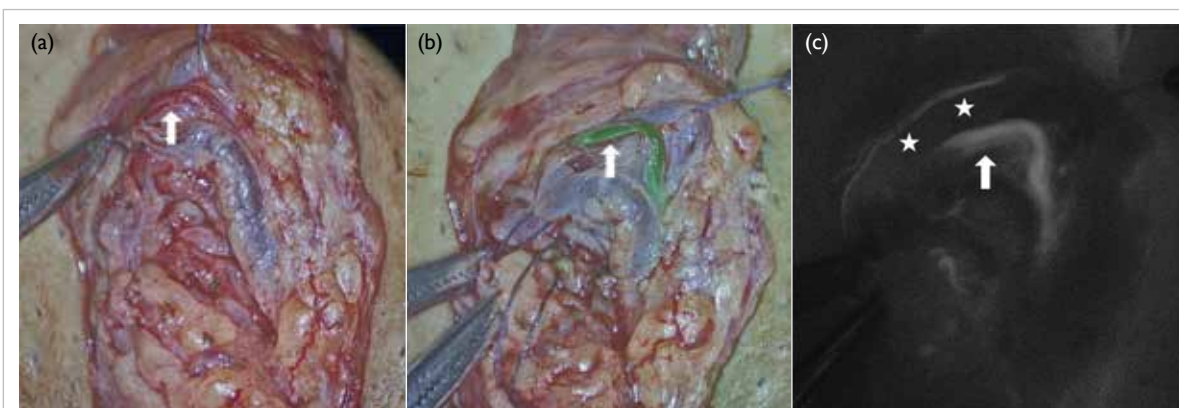


FIG 1. Intra-operative indocyanine green angiography by IMAGE1 S™ 4U RUBINA™ fluorescence imaging system. (a) The testicular artery is exposed under the white light microscopic view after retraction of the dilated internal spermatic veins. (b) The testicular artery is confirmed and appears green in the overlay mode with background white light images. (c) The testicular and cremasteric arteries are clearly demonstrated in monochromatic mode. The testicular and cremasteric arteries are denoted by arrows and stars, respectively

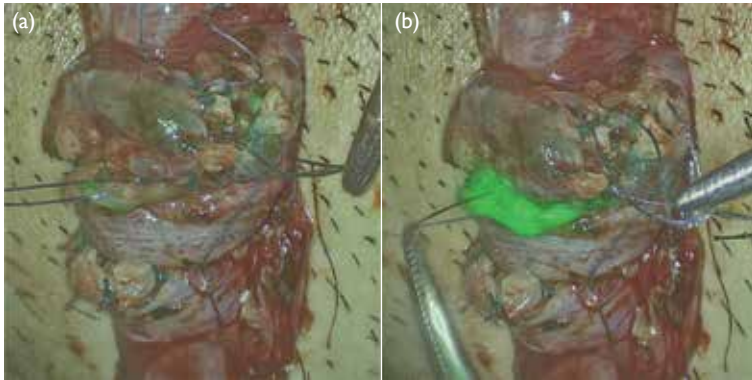


FIG 2. Intra-operative indocyanine green lymphography by IMAGEI S™ 4U RUBINA™ fluorescence imaging system (a) before and (b) after injection of indocyanine green

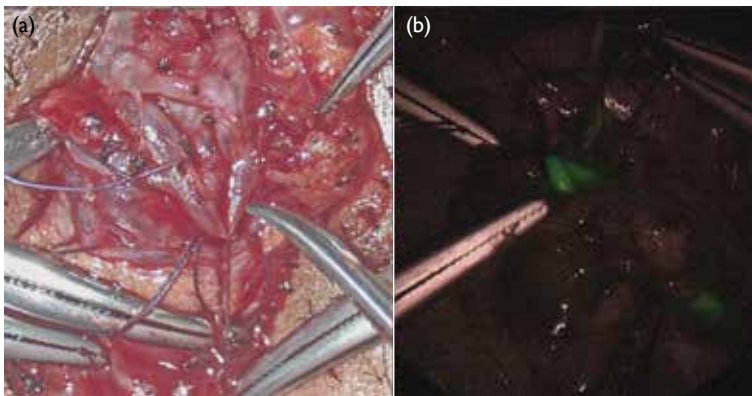


FIG 3. Intra-operative indocyanine green (ICG) angiography with the previous fluorescence imaging platform utilising VITOM II ICG system with SPIES camera (KARL STORZ SE, Tuttlingen, Germany). Without the overlay mode, the images of (a) white light microscopy view and (b) Chroma mode can only be analysed separately. Correlation between the testicular arteries identified on ICG angiography and white light microscopy can be difficult

identification of testicular arteries and lymphatics under white light microscopy alone is operator-dependent and remains challenging for novice surgeons. Several adjuncts have been introduced to facilitate artery- and lymphatic-sparing procedures during MSV. One such adjunct is ICG fluorescence imaging.¹ In our opinion, the new overlay mode provided by the latest platform is particularly useful for MSV. Without the need to switch between different modes, the combined regular white light image and near-infrared/ICG data allow accurate localisation of even the smallest vessel without

ambiguity (Fig 3). Moreover, the display of ICG signal alone in white on a black background in the monochromatic mode maximises contrast and further improves identification of target vessels (Fig 3). We believe the advances of this surgical platform and imaging technology play a role in enhancing patient safety by increasing the success of arterial and lymphatic preservation in MSV.

Author contributions

Concept or design: CL Cho.
 Acquisition of data: All authors
 Analysis or interpretation of data: All authors.
 Drafting of the manuscript: All authors.
 Critical revision of the manuscript for important intellectual content: All authors.

All authors had full access to the data, contributed to the study, approved the final version for publication, and take responsibility for its accuracy and integrity.

Conflicts of interest

The authors have disclosed no conflict of interest.

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Ethics approval

Patients were treated in accordance with the Declaration of Helsinki. Patients provided written informed consent for the procedures, and verbal consent for publication.

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