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# Enhanced Imaging

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Enhanced imaging is an overused phrase or buzzword, a seemingly all-encompassing term used to describe high definition imaging, 3-D imaging and fluorescence imaging. In reference to fluorescence imaging, however, this is actually a very descriptive term as the Indocyanine green (ICG) used, which is excited by near infrared (NIR) light, truly does enhance the image seen via white light. As President Harry S Truman said, 'There is nothing new in the world except the history you do not know' and indeed, ICG has been around for over 50 years as an adjunct to standard imaging [1]. Recently there has been a virtual explosion of interest in use of ICG fluorescence imaging as surgeons have recognized the various potential of this technology to improve on patient care in a large number of arenas. Three general uses of this technology, each of which capitalizes on specific characteristics of ICG, have been explored in depth and each are covered in the manuscripts in this special supplement.

The first of these, fluorescence angiography, is also the area in which I am deeply interested [2–4]. Real time assessment of blood supply promises to allow us to judge adequacy of tissue perfusion at the site of an anastomosis. Surgeons have long postulated that inadequate blood supply is a major contributor to anastomotic leaks, but have lacked efficient and usable tools to assess blood supply or test this hypothesis. My own work, along with my PILLAR II Investigator colleagues, has proven feasibility of the technology during anterior resection, with promising results [3] that are currently being tested in a Phase 3 randomized controlled trial (PILLAR III). Three articles in this special supplement cover this topic quite nicely, with Grone and Kreis' single institution study reporting similar results to PILLAR II, while James and Hompes' paper providing an excellent updated review of the available published literature to date. Ris and colleagues, in another manuscript, discuss what may be considered the 'Holy Grail' of this technology, namely the ability to use it not just to lower leak rates but to predict the need for a diverting ileostomy, a seemingly mandatory part of a high risk low anterior resection in 2015. The benefit of this discriminatory ability, if proven, will truly be a game changer, as this would have huge impacts to a very large number of patients in terms of quality of life and morbidity, as well as major health care cost savings.

Of course, the value of real time assessment of microperfusion is not limited to anterior resection, but has also been explored for sleeve gastrectomy [5], esophagectomy [6,7], and kidney transplants [8,9] just to name a few. Novak and colleagues, in another excellent manuscript in this supplement, describe their experience with imaging for acute mesenteric ischemia. Perhaps we can finally put away the Woods lamps and the fluorescein! The second area of intense interest is in fluorescence enhanced lymphatic imaging, to improve sentinel lymph node identification and also to allow nodal mapping as is elegantly described by Furajii and Cahill in their contribution in this supplement. Feasibility for sentinel node mapping has also been described for breast cancer [10], melanoma [11] and gastric cancer [12], among others. The third area of active investigation is fluorescent cholangiography [13–15], which capitalizes on the excretion of ICG which is almost exclusively hepatic, with a well-timed injection allowing detailed

anatomic delineation of the extra hepatic bile ducts to hopefully improve the safety of cholecystectomy. Another consequence of ICG hepatic excretion which has been capitalized on, is identification and delineation of liver tumors, a topic covered nicely by Gossedge and colleagues in their contribution in this supplement. These authors also nicely cover other areas of investigation, which truly highlight the fact that the novel characteristics of ICG and NIR imaging will undoubtedly find other areas of clinical value. Physiologic imaging (e.g. blood flow) rather than just anatomic imaging (blood vessel) truly represents enhanced imaging.

### **Conflict of Interest**

Dr. Stamos has been a speaker and consultant for Olympus. He has also been a study principal investigator and speaker for NOVADAQ. He has received research grants and holds stock options from NOVADAQ.

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