A primer to image enhanced endoscopy

Since the introduction of fibre-optic gastroscope in the early 60 s, the biggest advancement in gastrointestinal Endoscopy was the introduction of image enhanced endoscopy (IEE). The breakthrough happened when Gono and colleagues from Olympus R&D invented Narrow Band Imaging (NBI) to enhance the features of the gastrointestinal mucosa that white light endoscopy alone would not achieve (1). Manipulating the illumination wave length to narrow band width, meant that they were able to demonstrate in detail about the vascular patterns of the gastrointestinal mucosa. Since then, NBI has been used widely in both upper and lower GI tract in combination with high magnification for accurately studying dysplasia and early carcinoma. Validated classification systems (e.g., BING classification for Barrett’s, NICE and JNET classification for colorectal polyp) are now widely adopted. Similar technology has now been adopted by Fujifilm in the Blue Light/Laser Imaging (BLI), however, the light source is more efficient being either a laser (Lasereo) or 4 LED multilight technology (Eluxeo) making it brighter, highly energy efficient and long lasting (2). Manipulation of captured image post-processing is also playing a major part in Image enhancement. The I-scan optical enhancement technology (Pentax Utilises) utilises both optical and digital enhancement thus providing high end IEE technology available for clinical use (3). High magnification endoscopy that is capable of magnifying over 100 times utilizing zoom lens in combination with the modern electronic chromoendoscopy has resulted in detailed assessment of the microvasculature and structure (pit patterns) of the GI tract in disease and health states. This brings us to confocal endomicroscopy (4) and endocytoscopy (5) that allows visualisation at cellular level. This is a giant leap in endoscopic imaging that not only allows us to see a different world of endoscopic Imaging it also allows detailed understanding of the pathophysiology of various disease states. Probe based confocal endomicroscopy system (Mauna Kea) utilises low power laser light source for tissue illumination with the resultant reflected fluorescence light captured via a pin hole with focal plane being the same for illumination and reflectance thus increasing the spatial resolution. It has been extensively studied in the GI tract as well as biliopancreatic applications. The advantage of pCLE lies in its ability to be used with any endoscopy system and visualise at cellular level thus lending to molecular imaging. On the other hand, it is also a limitation since it cannot be used widely in community setting outside of Academic centres. The combination of widefield scanning and detailed imaging of surface and subsurface epithelium is now achieved in the oesophagus with volumetric laser endomicroscopy (VLE) which is a new endoscopic imaging technology (NvisionVLE Imaging System, NinePoint Medical) utilizing advanced optical coherence tomography with near infrared light and balloon-centered imaging probes that produce scans of 6-cm segments of the oesophagus (6). This is particularly useful in Barrett’s surveillance endoscopy. Endocytoscopy (Olympus) is a variation from pCLE wherein higher magnification is achieved with a single integrated zoom lens providing continuous zoom-focus magnification up to 500× and observation range of 570 μm × 500 μm incorporated in a standard gastroscope and colonoscope. This allows real time viewing at cellular level during routine upper or lower GI endoscopy thus allowing both wide field imaging and point focus imaging of abnormal areas. Capsule endoscopy has finally captured the last frontier in luminal imaging, the small bowel. Recent advancements in hardware and software allows capsule studies read in less than 30 minutes with high accuracy. The future of diagnostic endoscopy lies in the field of Artificial Intelligence thus minimising human error and maximising efficiency. This special series focused on “advanced endoscopic imaging of the GI tract” brings in the world leaders of GI endoscopy to present a ‘state of the art’ review of this modern technology with a perspective of future endoscopist in the 21st century.

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