Communication from the ASGE Technology Committee

TECHNOLOGY STATUS EVALUATION REPORT

High-definition and high-magnification endoscopes

The American Society for Gastrointestinal Endoscopy (ASGE) Technology Committee provides reviews of existing, new, or emerging endoscopic technologies that have an impact on the practice of GI endoscopy. Evidence-based methodology is used, with a MEDLINE literature search to identify pertinent clinical studies on the topic and a MAUDE (U.S. Food and Drug Administration Center for Devices and Radiological Health) database search to identify the reported complications of a given technology. Both are supplemented by accessing the "related articles" feature of PubMed and by scrutinizing pertinent references cited by the identified studies. Controlled clinical trials are emphasized, but, in many cases, data from randomized, controlled trials are lacking. In such cases, large case series, preliminary clinical studies, and expert opinions are used. Technical data are gathered from traditional and Web-based publications, proprietary publications, and informal communications with pertinent vendors.

Technology Status Evaluation Reports are drafted by 1 or 2 members of the ASGE Technology Committee, reviewed and edited by the Committee as a whole, and approved by the Governing Board of the ASGE. When financial guidance is indicated, the most recent coding data and list prices at the time of publication are provided. For this review, the MEDLINE database was searched through October 2013 for articles related to endoscopy by using the keywords "high resolution," "high definition," "high magnification," and "magnifying endoscopy."

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BACKGROUND

Video endoscopy permits the endoscopist to examine GI mucosa and identify abnormal tissue. The quality of endoscopic visualization is a function of both resolution and magnification. Video resolution is defined as the ability to optically distinguish 2 closely approximated objects or points and is a function of pixel density (the number of pixels wide × the number of pixels or lines of height). High-resolution imaging improves the ability to discriminate detail, whereas magnification enlarges the image. This report reviews advances in white-light high-resolution/-definition and high-magnification endoscopic imaging systems.

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TECHNOLOGY UNDER REVIEW

Standard definition (SD) signals offer images in a 4:3 (width:height) aspect ratio, with image resolutions of 640 to 700 horizontal pixels (width) × 480 to 525 vertical pixels (height) or "lines" (~367,000 pixels).[1] SD (640 × 480) displays, such as cathode-ray TVs, have approximately 300,000 pixels.[1] SD endoscopes are equipped with charge-coupled device (CCD) chips that produce an image signal of 100,000 to 400,000 pixels, which are displayed in the SD format. Advances in CCD and, more recently, in complementary metal-oxide semiconductor (CMOS) technology have resulted in smaller chips with an increased number of pixels and increased resolution. The chips used in current high-resolution or high-definition (HD) endoscopes produce signal images with resolutions that range from 850,000 pixels to more than 1 million pixels (Table 1).

The general consensus definition of a HD image or display and the definition of high definition for the purposes of this review are one with more than 650 to 720 lines of resolution.[2] Details of HD displays have previously been discussed in another technology committee document.[3] Briefly, HD image displays can refresh on a line-by-line scan, which may be progressive (p) or interlaced (i). Progressive scanning provides twice the temporal resolution (60 frames/s) of interlaced scanning (30 frames/s) and is better for video display of fast-moving objects.

HD video imaging can be displayed in either TV or computer monitor formats. Broadcast HD TV is available in 3 standard formats, 720p, 1080i, and 1080p, all in a 16:9 aspect ratio. The 16:9 aspect ratio is not useful for display of images originating from round endoscopic lenses. Historically, SD endoscopic images have been displayed in a 4:3 aspect ratio to match the standard aspect ratios of SD TV. This ratio provides the highest pixel density and resolution possible, given the endoscope lens shape. HD endoscopic video chips display images in either 4:3 or 5:4 aspect ratios.

To provide true HD image resolution, each component of the system (eg, the endoscope video chip, the

TABLE 1. High-resolution and high-magnification endoscopes available in the United States

		Olympus America Inc (Center Valley, Pa)							
		Gastroscope				Colonoscope			
Model no.		**GIF–H190**	**GIF–HQ190**	**GIF–XP190N**	**GIF–Q160Z**	**PCF–PH190L/I**	**PCF–H190L/I**	**CF–HQ190L/I**	**CF–Q160ZL/I**
Optical system	Field of view, deg	140	Normal focus mode: 140 Near focus mode: 140	140	WIDE position: 140 TELE position: 75	140	170	Normal focus mode: 170 Near focus mode: 160	WIDE position: 140 TELE position: 50
	Depth of field, mm	2–100	Normal focus mode: 5– 100 Near focus mode: 2– 6	3–100	WIDE position: 8–10 TELE position: 1.5–3	2–100	2–100	Normal focus mode: 5–100 Near focus mode: 2–6	WIDE position: 7–10 TELE position: 2–3
Insertion section	Insertion tube outer diameter, mm	9.2	9.9	5.8	10.8	9.5	11.5	12.8	12.8
	Working length, mm	1030	1030	1100	1030	L: 1680 I: 1330	L: 1680 I: 1330	L: 1680 I: 1330	L: 1680 I: 1330
Angulation, deg	Up/down	210/90	210/90	210/90		180/180	180/180	180/180	
	Right/left	100/100	100/100	100/100		160/160	160/160	160/160	
Instrument channel	Channel inner diameter, mm	2.8	2.8	2.2	2.8	3.2	3.2	3.7	3.7
Water jet function		Yes	Yes	No		No	Yes	Yes	
Additional CE		NBI	NBI	NBI	NBI	NBI	NBI	NBI	NBI
HD format, pixels		1280 × 1024	1280 × 1024	1280 × 1024	640 × 480	1280 × 1024	1280 × 1024	1280 × 1024	640 × 480
Magnification		D, ×1.5	D, ×1.5; O, ×150	D, ×1.5	D, ×1.5; O, ×115+	D, ×1.5	D, ×1.5	D, ×1.5; O, ×150	D, × 1.5; O, ×150
Price, US$		40,000	42,000	38,000	†	44,000	46,000	46,000	
Processor, price, US$		Evis Exera III (CV-190) 26,000	Evis Exera III (CV-190) 26,000	Evis Exera III (CV-190) 26,001		Evis Exera III (CV-190) 26,002	Evis Exera III (CV-190) 26,003	Evis Exera III (CV-190) 26,004	
Light source, price, US$		Evis Exera III (CLV-190) 15,000	Evis Exera III (CLV-190) 15,000	Evis Exera III (CLV-190) 15,000		Evis Exera III (CLV-190) 15,000	Evis Exera III (CLV-190) 15,000	Evis Exera III (CLV-190) 15,000	

Deg, degrees; *TELE*, *L*, long version; *I*, intermediate version; *CE*, contrast enhancement; *NBI*, narrow-band imaging; *FICE*, Fujinon image contrast enhancement; *HD*, high-definition; *D*, digital; *O*, optical.
*HD format assumes pairing with EPK-i7000 processor.
†Requires MAJ–570, which is an additional cost.

processor, the monitor, and transmission cables) must be HD compatible. When the number of pixels and aspect ratio of the video source match those of the display, the highest possible image resolution or native resolution is displayed. HD processors and monitors can up-convert input image signals, such as from SD endoscopes, through pixel interpolation that may limit image quality.

Three different HD endoscope systems are currently available in the United States (Table 1). Olympus America