

## Digestive endoscopy in five decades

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**ABSTRACT** – The world of gastroenterology changed forever when flexible endoscopes became available in the 1960s. Diagnostic and therapeutic techniques proliferated and entered the mainstream of medicine, not without some controversy. Success resulted in a huge service demand, with the need to train more endoscopists and to organise large endoscopy units and teams of staff. The British health service struggled with insufficient numbers of consultants, other staff and resources, and British endoscopy fell behind that of most other developed countries. This situation is now being addressed aggressively, with many local and national initiatives aimed at improving access and choice, and at promoting and documenting quality. Many more consultants are needed and some should be relieved of their internal medicine commitment to focus on their specialist skills. New instruments and procedures are stretching the diagnostic boundaries and changing the interface with sister disciplines like radiology, surgery and pathology. The old distinctions, particularly between gastroenterology and surgery, are increasingly irrelevant and unhelpful. The future is bright for gastroenterology and for endoscopy, but unpredictable. In this fast-changing world it will be essential to remain flexible, with our goals firmly focused on the best interests of our patients.

**KEY WORDS:** accountability, diagnostic endoscopy, digestive surgery, fibre-optics, pathology, quality, radiology, therapeutic endoscopy, training

The practice of digestive medicine changed irrevocably with the introduction of commercial flexible fibre-optic endoscopes in the 1960s. Gastroenterology at that time was a simple contemplative endeavour. Many digestive complaints were attributed to stress and treatments were restricted to diet, antacids and bed rest. Diagnosis relied on clinical acumen, aided by barium studies and analyses of gastric acid and faecal fat. Jejunal biopsy and liver biopsy (and exploratory laparotomy) were the only invasive diagnostic procedures. Endoscopy was limited to rigid proctoscopy and occasional esophago-

scopy. So-called semi-flexible gastroscopes were cumbersome and used infrequently by only a few enthusiasts.

### Diagnostic endoscopy

The first truly flexible gastroscope was developed in the USA,<sup>1</sup> following pioneering work on fibre-optic light transmission in the UK by Harold Hopkins.<sup>2</sup> However, commercial production of endoscopes was rapidly dominated by Japanese companies, building on their earlier expertise with intragastric cameras.

My involvement began in 1968, whilst doing bench research with Dr Brian Creamer at St Thomas' Hospital, London. An expert in coeliac disease (and jejunal biopsy), he opined that gastroscopy might become useful and legitimate only if it became possible to take target biopsy specimens – since no one seriously believed what endoscopists said that they saw. Shortly afterwards, Truelove's group in Oxford described their experience with the first Olympus side-viewing gastroscope with biopsy capability.<sup>3</sup> We obtained an instrument and a career was launched. Views and photographs were remarkably good. Gastric ulcers and their risk of malignancy were a major concern at that time, so gastroscopy became accepted relatively quickly. Gastroenterologists in the West pressed manufacturers to produce forward-viewing instruments, which allowed examination of the oesophagus and duodenum, as well as the stomach. There followed a series of articles from endoscopic enthusiasts claiming that endoscopy was more accurate than the standard barium meal in the context of dyspepsia, bleeding and the operated stomach. These studies were somewhat flawed since the findings at endoscopy were used as the gold standard!<sup>4,5</sup> Endoscopy gradually became the first-line investigation for most patients with suspected upper digestive disease. This evolution was not without its skeptics, especially those who believed (perhaps based on unfortunate experiences with rigid esophagoscopy) that it was dangerous to attempt passage of an endoscope without barium confirmation of a patent oesophagus.

The first attempts at flexible sigmoidoscopy and colonoscopy were reported in the late 1960s,<sup>6</sup> and included some bizarre athletic adventures.<sup>7</sup> Improvements in the flexibility of instruments and the developing skills of some experts eventually

allowed fairly routine colonoscopy. At that stage there was no thought that colonoscopy would become a primary diagnostic tool.

Endoscopic retrograde cholangiopancreatography (ERCP) was an extraordinary development at a time when biliary and pancreatic diseases were diagnosed with palpation, plain radiographs and laparotomy. There were no scans and percutaneous transhepatic cholangiography was used in very few centres. The first description of endoscopic cannulation of the biliary or pancreatic duct appeared in 1968 in the USA, but included no data or radiographs.<sup>8</sup> The watershed came when Japanese groups worked with endoscope manufacturers to produce purpose-designed instruments. Presentation of some ERCP pictures at Digestive Disease Week in 1970 caused a sensation. I was fortunate enough to spend 2 weeks with Dr Kazuei Ogoshi in Niigata in 1971, and I brought the technique back to Britain.<sup>9</sup> It has been the main focus of my clinical life and research ever since.

### Therapeutic endoscopy

If diagnostic endoscopy was exciting, the subsequent therapeutic revolution was truly amazing. The decade from the early 1970s saw the rapid development of a host of endoscopically based treatments, including the management of oesophageal obstruction, foreign bodies and acute gastrointestinal bleeding.<sup>10,11</sup> Colonoscopic polypectomy was truly a breakthrough in colorectal medicine.<sup>12</sup> Therapeutic ERCP revolutionised the management of biliary obstruction, with the introduction of biliary sphincterotomy for removal of stones<sup>13</sup> and the use of plastic stents to relieve jaundice.<sup>14</sup> Percutaneous endoscopic gastrostomy soon followed.<sup>15</sup>

### Establishment resistance

It is difficult to overstate the impact of this barrage of endoscopic therapy. Embraced rapidly by young and enthusiastic endoscopists, it was questioned by many academic gastroenterologists and seriously resisted (even resented) by much of the surgical community. For instance, erudite studies concluded that endoscopy for acute gastrointestinal bleeding was not worthwhile since it did not seem to improve outcomes. To me this seemed illogical. If a better diagnostic process did not improve outcomes, it was time to develop better treatments; indeed, endoscopic haemostasis soon became available and widely accepted. There was resistance to biliary sphincterotomy and much misleading literature from people comparing apples with oranges.<sup>16</sup> The then President of the Royal College of Surgeons, Sir Rodney Smith, stated that the College might permit stone extraction by a few gastroenterologists, but that the College should 'charge corkage'. Biliary stenting for relief of jaundice in patients with advanced malignancy also seemed to be a major improvement over surgical bypass, but it took a randomised controlled trial (consuming 10 years from initiation to publication) to prove the obvious.<sup>17</sup>

The tidal wave of enthusiasm for endoscopy threatened the gastroenterology establishment. Many leaders of our profession

were dubious if not dismissive of their younger colleagues who embraced 'technical' rather than 'cognitive' pursuits. Chris Booth, President of the British Society of Gastroenterology (BSG), asked 'Will the gastroenterologist become merely a technician?' Solly Marks made the same point, but with characteristic humor, when he said 'Consider the whole patient, not just the hole in the patient'. The disinterest of the BSG leadership led to the formation of a separate endoscopy society – the British Society for Digestive Endoscopy.<sup>18</sup> This effectively fostered the endoscopic child in the UK, but further aggravated the schism with the establishment.

### Burden of success

The third decade – from the mid-1980s – was a period of consolidation and widespread dissemination. Diagnostic and therapeutic endoscopy became broadly accepted and spread to the far corners of the earth. Endoscopy societies sprang up in most countries. Paradoxically, the British Society for Digestive Endoscopy (under my presidency) decided to disband in 1980 and was folded back into its parent organisation, the BSG.<sup>19</sup> The reason for this was simple: I believed, and the membership agreed, that endoscopy is a tool to be used by digestive specialists, not a specialty of its own.

The obvious success of endoscopy brought heavy responsibilities and significant frustration. There was an insatiable demand for teaching and an urgent need to develop efficient endoscopic services. What started as an occasional toy had become a major commitment. We struggled to develop endoscopy units, to train endoscopy nurses and to establish appropriate professional support structures. A gross shortage of consultants, the distractions of private practice, the ever present commitment to acute general medicine and the severe lack of resources made it impossible to provide services of high quality. Reports documenting the urgent needs were largely ignored. These frustrations led to my move to the USA in 1986, after reflection during a 6-month 'sabbatical'.

### Current status and developments

Digestive endoscopy has continued to evolve over the past two decades. I will discuss three main streams of change – endoscopic advances, developments in related fields and the increasing focus on quality and accountability.

#### *Endoscopic advances*

The ingenuity of the instrument companies and the vision of a few endoscopic pioneers have driven continuing proliferation of endoscopic technology in two almost opposite directions. One thrust is to make diagnostic procedures simpler and more accurate in the face of the increasing complexity of therapeutic endoscopy. Endoscope design reflects these divergent goals. There are now small-calibre screening endoscopes that can be used without sedation, and even through the nose, while therapeutic endoscopes are becoming more complex. The change

from fibre-optic endoscopes to videoscopes had many advantages, not least freeing up the field of view for everyone in the room (and saving many an endoscopist's neck). More important, the increasing miniaturisation and sophistication of CCD devices has dramatically improved image quality. Mucosal detail can be enhanced also by using dye enhancement techniques (chromoscopy) and different light spectra.<sup>20</sup> Techniques such as optical coherence tomography and con-focal microscopy are producing endoscopic images which compare with histological slides.<sup>21</sup> Together these developments allow serious discussion of 'optical biopsy' in the future, reducing the need for histological confirmation, with its inevitable delays.

The development of the wireless endoscopy capsule was an extraordinary achievement and a milestone in the history of endoscopy, indeed of medicine.<sup>22</sup> Whilst initially used only for the investigation of patients with obscure small bowel bleeding, technological developments are leading rapidly to broader applications, including in the oesophagus and colon.

Another diagnostic breakthrough was the ability to see beyond the mucosa. Endoscopic ultrasonography – after a slow start – is now practised widely, particularly for diagnosis and staging of smaller tumours.<sup>23</sup> The fine-needle aspiration capability added crucial pathological confirmation and converted many skeptics.

Attempts are being made to facilitate the practice of colonoscopy using image guidance, variable stiffness and even self-advancing and self-steering endoscopes. A double-balloon system has been developed to facilitate the passage of endoscopes throughout the small intestine.

The increasing computerisation of endoscopy opens new doors for the future. The digital revolution allows the transmission of images for teaching and distance learning, and provides opportunities for image analysis. But there is also the potential for 'intelligent endoscopes', which can track their own usage, and learn to make diagnoses and even to prompt the endoscopist's arm or brain. Computer simulation will eventually become a crucial part of endoscopic training, assessment and revalidation.<sup>24</sup>

There have been equally impressive developments in therapeutic endoscopy during the past 20 years. Haemostatic techniques have improved, stents have become larger and expandable, and the technique of endoscopic mucosal resection, developed in Japan, is gaining increased acceptance in the West.<sup>25,26</sup> Sessile neoplastic lesions in the oesophagus, stomach and colon are now being removed by snare and needle-knife resections after lifting them up with a 'saline cushion'. ERCP endoscopists are treating many aspects of pancreatitis and are trying to make sense of sphincter dysfunction.<sup>27,28</sup>

Peroral endoscopic surgery is the new frontier. Numerous methods have been proposed to perform endoscopic fundoplication.<sup>29,30</sup> Clinical results are variable, but the principle has been established. Innovative individuals and consortia, such as the Apollo Group, are increasingly 'thinking outside the box' and are now breaching another barrier – the stomach wall. To most endoscopists the word 'perforation' is chilling. Now, young endoscopic tigers are intentionally perforating the stomach to

explore the abdominal cavity from the mouth. Peroral gastroenterostomy, fallopian tube ligation and cholecystectomy have been described in the animal laboratory,<sup>31,32</sup> and human appendectomies have been reported by this method. Many groups are attempting to develop endoscopic treatments for obesity, mainly through reducing the size of the stomach.

These new therapeutic frontiers demand a fundamental rethink of endoscopic design and the next generation will look completely different. The use of sleeves, multiple channels and multiple endoscopes through sleeves will greatly enhance endoscopic capabilities. The recent development of an endoscopic 'sewing machine', as well as clipping and stapling devices, provides a powerful new armamentarium. There are some exciting experiments with endoscopic robots.<sup>33</sup>

### *Developments in related fields*

Another important theme is the relationship between digestive endoscopy and all the other technologies (and specialties) that can impact on patients with digestive problems. The primary 'competitors' are radiology and surgery.

Apart from the early experimental years, radiologists have shown little interest in the combined endoscopic/radiological procedures, such as ERCP and endoscopic ultrasound (EUS). This is largely because of their preoccupation with the proliferation of imaging techniques, including ultrasound, computed tomography, magnetic resonance (MR) scanning and positron emission tomography. The increasing sophistication of CT and the development of MR cholangiopancreatography (MRCP) certainly impact on the indications for some endoscopy procedures, particularly ERCP. Whilst ERCP occasionally can make a diagnosis when less invasive techniques fail, it is increasingly becoming a therapeutic procedure.<sup>34</sup> The latest radiological 'threat' to endoscopy is the development of CT colonography, also known as virtual colonoscopy. When done by experts with state-of-the-art techniques, CT colonography appears to have good accuracy in the detection of colonic neoplasms.<sup>35</sup> Whether it is ready for 'prime time', ie for widespread community screening, is a topic of hot debate.<sup>36</sup> Several large multicentre studies suggest that the accuracy is less than optimal in general use.<sup>37</sup> As technology and training improve, and particularly if 'prep-less' examinations become a reality, CT colonography will play an important role in colorectal medicine. Estimates of its likely impact on the practice of colonoscopy vary widely.<sup>36</sup> Interventional radiologists also have many sophisticated techniques applicable to patients with digestive problems, notably bleeding and biliary obstruction. Thus, the interface between endoscopy and radiology (starting with arguments about the barium meal) remains in an interesting flux.

The interface with surgery also continues to change. In the earlier years, surgery was aggressive, ablative and risky. This all changed around 1980, with the sudden embrace of 'keyhole surgery', spearheaded by laparoscopic cholecystectomy (albeit with little scientific validation). Minimally invasive techniques are now applicable in many abdominal conditions. Along with improvements in anaesthesia and perioperative care, this has

brought a welcome reduction in the burdens of surgery. This dilutes or negates the obvious earlier advantages of endoscopic therapy. For instance, laparoscopic myotomy has taken the wind out of the sails of balloon dilation and Botox techniques for the treatment of achalasia, and it is no longer correct to assume that endoscopic sphincterotomy for stone is safer than a surgical approach. Older endoscopists grew up with the idea that referring a patient for surgery was a sign of failure; now it is often the smart approach. These facts, which will continue to change, have major implications for the organisation of training and clinical practice in the future.

### *Quality and accountability*

*Restructuring the specialties.* Providing precisely the right services (and in the most efficient sequence) is more difficult as medicine becomes more complex, and as physicians become more specialised. The phrase 'for those who have a hammer, everything looks like a nail' is pertinent in the world of super-specialised endoscopists and surgeons. The risk that patients may get the wrong procedure (or are delayed in getting to the right service) if they enter the healthcare system through the wrong door must be minimised by increasing collaboration between specialties. Nowadays, there is little apparent difference between an aggressive endoscopist and a minimally invasive surgeon (or an interventional radiologist). They look and dress alike, and all work through instruments whilst observing on television screens (Fig 1). The boundary between gastroenterology and surgery is surely fading.<sup>38</sup> The time-honored distinctions have less meaning, indeed are becoming an obstacle to optimal medical care. This is the vision behind the Digestive

Disease Center, which I initiated on moving to the Medical University of South Carolina in 1994.<sup>39</sup> Gastroenterologists and surgeons live and work in the same environment, with joint facilities and support staff. We have a 'patient-friendly' focus, an infrastructure to facilitate that goal, and the clinical research and postgraduate education needed to improve care in the future. The Center's approach is being adopted increasingly by many large hospitals in the USA, but is often resisted by the heads of traditional academic departments (notably medicine and surgery), where much of the power and money remain. Eventually, I believe there will be departments of 'digestive medicine'.<sup>39</sup> Graduates from medical school with an interest in digestive disease will enter a period of training in 'digestive science', during which they will decide whether they wish to practise consultative gastroenterology, to follow a traditional surgical route or to become one of a new breed of 'therapeutic digestivists', embracing all the techniques of minimally invasive surgery and flexible endoscopy.

*Training, quality and accountability.* We are all interested in doing our job as well as possible. Only in recent years, however, has there been greater formal exploration of what this means and how quality can be improved. One imperative is to facilitate and speed endoscopic training, and to provide later learning opportunities in breakthrough technologies.<sup>40</sup> The development of 'train the trainers' schools, formalised curricula and computer simulators are examples of the new focus. Our methods for assessing competence and expertise in endoscopy have been far too subjective.<sup>41</sup> When objective measures are used, the recommended training 'numbers' usually appear far too low.<sup>42</sup> Endoscopists should be credentialed (validated) based on



Fig 1. Interventional gastroenterologists, surgeons and radiologists all look the same nowadays.

measurable cognitive and technical skills. Computer simulation may help this process, also.

The mirror of quality is accountability. We should know exactly what we are doing, compare this with our peers (benchmarking) and make the data available to any interested parties, whether they are patients, providers or payers. I support the 'report card' concept.<sup>43,44</sup> Endoscopists should collect basic data on their endoscopic practice and outcomes, and make them available on request to anyone interested. This will provide a competitive advantage eventually and ties in with the move towards 'pay for performance' in the USA. Data collection is increasingly easy as our environments become more electronic.

### Endoscopy in the USA

Endoscopy has thrived in the USA, where the environment encourages and rewards both technical innovation and procedural volume. As in many aspects of American life, the best is very good. For most patients and gastroenterologists, waiting lists are a foreign concept. The American Society for Gastrointestinal Endoscopy has been a powerful advocate for education, research and high-quality practice. Training is highly structured and much shorter than in Britain. The American graduate now does 3 years of medicine residency, followed by a 3-year full-time gastrointestinal fellowship. Two of these years cover all aspects of gastroenterology and hepatology, including the basic procedures, and the third is spent in research or on a more specialised clinical focus. All procedures in academic centres are fully supervised by specialist staff, day and night. The National Board examination is recognised as the stamp of qualification as a gastroenterologist. A few trainees choose to do an additional year with a specific focus, such as advanced endoscopy, outcomes research training or transplant hepatology. There are well-compensated positions available for all graduates. There are about 1,000 gastrointestinal fellows currently in training, yet people worry about a shortage of gastroenterologists, largely because of the demands for colonoscopy. This now dominates the lives of many community gastroenterologists, driven recently by the huge increase in screening examinations. It will be interesting to see whether the USA will ever embrace the non-physician endoscopist model pioneered in Britain, and also, what may happen if and when the demand for colonoscopy diminishes with improvements in virtual procedures and genetic testing. Although there are complaints from academic centres about recent pressures for more service work, the national meetings show that there are still large numbers of endoscopists able and interested to pursue high-quality research.

Of course, the USA also has its dark side. Medicine is highly bureaucratic and access is patchy. Endoscopy is probably over-utilised in some areas, and there are problems with costs and quality. Across the country, approximately half of all endoscopy procedures are done by internists, surgeons and primary care physicians; their training in endoscopy is less structured and their expertise varies. Fortunately, there is increasing patient awareness of practice variations and a national emphasis on the

quality of procedures, which will be greatly strengthened by the move to link compensation to proven value.

### Endoscopy in Britain

For about 15 years after I left England, I watched, sadly, and from a comfortable distance, the waning of Britain's influence in the world of endoscopy. With a few notable exceptions, the innovations in practice, teaching and assessment were being made in other countries. Pressure of every day work had taken precedence. A wish to do better stimulated many careful reports and useful recommendations by bodies such as the BSG and the Joint Advisory Group (JAG), but these were largely ignored. Resources were grossly inadequate. The profession became frustrated at not being able to provide adequate quality services and many consultants could not wait to retire. Much valuable energy was expended in private practice procedures.

But the situation has changed recently. I applaud the recent efforts to support and improve endoscopy services in Britain. Much of the current emphasis on endoscopy derives from its role in diagnosis and as part of the national effort to reduce the long waiting times for cancer treatment. This is fortunate, but also somewhat ironic, when the real future of endoscopy lies in its therapeutic contributions. Other important signs include the increased prominence of JAG, the work of the Modernisation agency (now superseded), the appointment of clinical leads in endoscopy, the development of formal training structures and centres, the assessment of endoscopy units, and audits of real day-to-day practice. This plethora of initiatives is somewhat confusing (at least to me) and it is not clear who really has line authority to coordinate and pursue the necessary improvements at the coal face. Fortunately, patients are becoming more knowledgeable and more demanding of their healthcare providers. They will and should drive the agenda. The recent increase in consultant numbers is welcome, but far from adequate, especially now that trainees are to be trained rather than used mainly to support the service. Projections indicate that it will be more than a decade before enough specialists are in place. In earlier years, demoralised time-expired senior registrars fought for consultant positions that rarely suited or recognised their talents, and were expected to do much the same job for 30 years. The recent increase in consultant posts allows much greater flexibility and even an open market for specialist skills. This will recognise and reward energy and excellence, which were often punished in the past. The full flowering of gastroenterology in Britain is still hampered by the commitment to general medicine, both in training and in practice. Surely, some consultant posts should be restricted to gastroenterology (including hepatology, nutrition, etc), with fast-track training (of 3 years) leading into them. The work-span of consultants could be extended by allowing more flexibility in working practices, eg by dropping the on-call commitment at a certain age. Centres of excellence must be expanded and fully supported to innovate, evaluate, teach and inspire. High quality clinical research should be encouraged. This is a critical time for British gastroenterology and endoscopy. Prospects are improving, but the new

enthusiasm in the profession will be dampened again if promises of improvement are not met, and the momentum could be lost.

## Conclusion

After all that has happened in the world of digestive endoscopy, it is tempting to assume that the golden days are over. That would be wrong; the future is bright. Intelligent endoscopes and peroral transgastric surgery may seem foolish concepts now, but may well be routine in a decade or two. The practice of gastroenterologists now entering the profession will be unrecognisable in their mature years. Many of the diseases that we now hunt and manage will be eliminated by prevention or new medical treatments, and our diagnostic and therapeutic tools will become both less invasive and more precise. If given appropriate resources and incentives, British gastroenterologists certainly have the intelligence and dedication to play a major role in moulding that future. I cannot predict how important endoscopy may be in that distant day, but suggest that we keep our focus on the patient's best interests and cling to the important attribute that got us started – flexibility.

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