

EVOLUTION OF PRACTICE

Gastrosopic painting

James Rose describes a time when science and art intersected with striking results

Early endoscopists realised the importance of recording their findings. Although small cameras had been used to take gastrophotographs in the mid-19th century, the slow film speed and low light intensity of the electric bulbs in gastroscopes made photography impractical.¹ Coloured paintings were the only medium that could accurately represent what was seen. During the 30 years before photographic techniques improved, almost 600 coloured paintings were published. Little has been written of the artwork or the artists who enabled the internal world revealed to the gastroscopist to be appreciated by the wider medical community.

Association between painting and endoscopic photography

An endoscopic photograph appeared in the *BMJ* as early as 1883,² and Norbert Henning took gastrophotographs through the rigid endoscope and used them to illustrate his books on gastroscopy and gastritis in the 1930s.³⁻⁴ These photographs could be enlarged and coloured for greater effect. But the introduction of the semi-flexible gastroscope proved too much for the photography of the time, when film speeds reached a maximum of ASA 2. This speed compares with a standard fast film of ASA 400 before the advent of digital photography.

In 1937 Rudolf Schindler considered “gastrophotography to be obsolete.”⁵ Thus, the technical limitations of photography allowed painting to flourish until further technical advances improved the quality of photographs.⁶ The introduction of fibreoptics into endoscopy once more initially reduced the quality of obtainable photographs, but not for long enough to allow a resurgence of drawing beyond the immediate recording of findings in the notes. With the digitisation of endoscopic images, gastroscopic painting has permanently lost its scientific value but remains of historical and artistic interest.

Historical considerations

Gastroscopy developed almost exclusively in German speaking countries from the end of the 19th century, perhaps because of the highly developed optical industry.⁷ However, these technical developments and the production of expensively illustrated books took place during the post-war inflation in the German economy. Fortunately, authors, publishers, and artists persisted with their efforts, sometimes being given generous financial assistance both locally and from the United States.⁸

In 1934, the newly elected German chancellor, Adolf Hitler, introduced a favourable rate of exchange for

foreigners, especially students, which made living and studying in Germany inexpensive. Encouraged by this and the development of the safer semi-flexible Wolf-Schindler gastroscope in 1932,⁹ a small group of British gastroscopists studied in Germany for a while, mainly with Henning, a pupil of Schindler, who had emigrated to the US.¹⁰ The group included Harold Edwards of King’s College Hospital, London; Harold Rodgers of St Bartholomew’s Hospital, London; Dudfield Rose of Newcastle upon Tyne; and Hermon Taylor of the London Hospital. The outbreak of the second world war had an adverse effect on the development of endoscopy. Many gastroscopists became military surgeons, and for those still working in civilian hospitals in the United Kingdom a lack of equipment and glossy paper prevented the development of endoscopic photography.

Technical limitations of early endoscopy

In the early days of endoscopy there were many limitations both for the observer and for the artist: the gastroscopic image was very small; the angle of view narrow; the light dim; and, unless the patient was very cooperative, the examination brief. Illumination was internal with a distal bulb supplied by external batteries. The bulbs became hot, and if used at full power for photography risked burning the mucosa.

The artistic challenge

Unlike the illustrators of the great anatomies, who could portray the static results of the dissection table in life-like poses, painters of endoscopic views usually had just a black circle in which to represent moving, living tissue seen briefly through an endoscope under

unusually difficult circumstances. In addition, only a monocular view could be obtained; there was a single light source, always bearing the same relation to the viewer; the colour range of the material was limited—mucosa appeared in various degrees of pink, with just a little mucus and bile for contrast; the colour of the mucosa altered with the distance from the light source; and the stomach, a living moving organ, would not pose for the benefit of the artist.

All these factors made depth, form, and contrast difficult to reproduce. However, the multiple lenses of the Wolf-Schindler gastroscope, acting as a blue filter, imparted a yellow tinge to the image, making it easier to differentiate the different shades of orange-red.⁵

Artists’ techniques

In the dark, artists made rapid rough pencil sketches with notes on colouring to be painted later. Patients could tolerate the examination for no more than five minutes, limiting the time during which artists could work from life. Many endoscopists did not have a medical artist. Edwards and Taylor, who illustrated their own observations, sketched during or immediately after the procedure and painted later (fig 1).

The wet sheen of healthy mucosa is difficult to represent. Most artists relied on careful painting of highlights using brush and pigment, whereas Frank Prosser experimented with painting on a glossy material, such as silk, or mounting the picture behind cellophane (fig 2A). Douglas Kidd used an airbrush to produce a highly characteristic appearance (fig 2B).

European contribution

The first printed pictures were probably those in Hans Elsner’s *Die Gastroskopie*, published in 1911 with

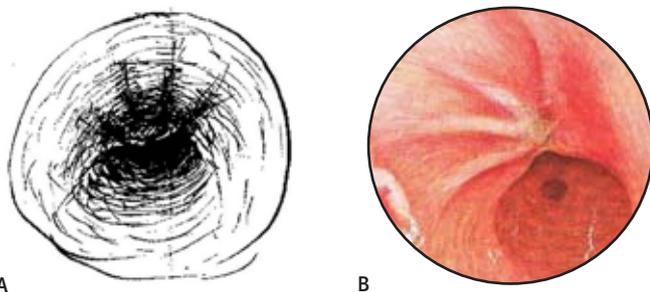


Fig 1 | Sketch (A) and print (B) of painting of lesser curve ulcer by Taylor (1936)



Surgery preservation society, p 32

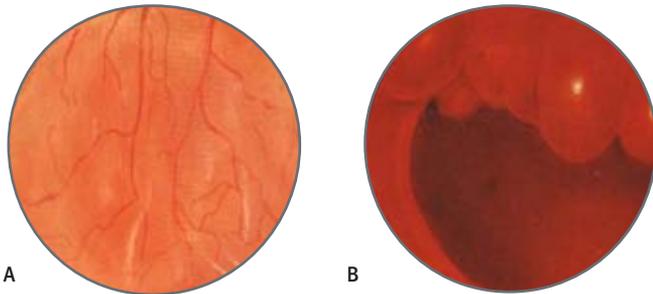


Fig 2 | Mucosal sheen in atrophic gastritis represented by Prosser using painted highlights under cellophane (A) and in gastric carcinoma by Kidd using an airbrush technique (B)¹¹

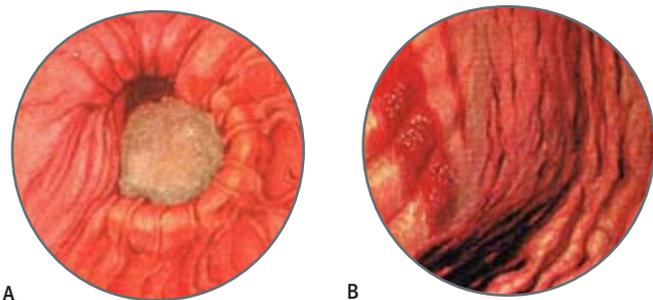


Fig 3 | Gastric diverticulum with mucus pool by Walther (A),⁸ and hypertrophic gastritis by Rose (B)^{4 13}

22 coloured endoscopic views of the stomach.¹² The next landmark was the publication in 1923 of Schindler's *Lehrbuch und Atlas der Gastroskopie*, with 117 gastrosopic paintings of normal and abnormal findings to help the practitioner interpret what was seen.⁸ The paintings by Erna Walther are crisply drawn and some are very attractive (fig 3A), but they provide no sensation of distance or of the glistening wetness of the mucosa.

In 1935 Schindler's pupil François Moutier published *Traité de Gastroskopie et de Pathologie*

Endoscopique de L'Estomac illustrated by Claire Escoube (fig 4A).¹⁴

The three dimensional aspect is well reproduced by M Landsberg, however, who worked for Arthur Hübner, reader in surgery at the University of Berlin. Hübner's *Gastroskopie* included 16 endoscopic paintings, several with corresponding resection specimens.¹⁵ Henning's popular pocket book *Lehrbuch der Gastroskopie* of 1935 was translated into English in 1937.^{3 16} It contained gastrosopic photographs,

watercolours, and coloured enlarged photographs, which appear darker and duller than the watercolours.

The greatest work of the era, *Gastroskopie* by Gutzeit and Teitge of Berlin and Breslau, was published in 1937. It contained 155 colour paintings by the university artist, Rose (not related to the author),^{4 13} and although there were separate illustration pages throughout, for the first time pictures were also integrated into the text, being printed separately and glued into place. The illustrations are of great educational value and are finely drawn, with a beautiful range of colour and a sense of depth (fig 3B).

Endoscopic painting in the UK

In 1935 the first paintings appeared in the UK literature, signed by N Streck, possibly Streck Loweski, one of the medical staff of the Kasr El-Ainy Hospital, Cairo.¹⁷ The six paintings are notable for their wide colour range and contrast, and the exotic conditions illustrated, such as the appearance of the gastric mucosa in an "alcohol opium coffee and tea addict heavy smoker" (fig 4B).

A comprehensive review of gastroscopy by Hermon Taylor contained 14 paintings by Margaret McLarty, showing normal appearances, a range of pathology (fig 4C), and the progress of an ulcer as it healed.¹⁸ The 40 fine paintings by Kidd demonstrate his characteristic smooth glossy technique.¹¹

Although as early as 1937 Dudfield Rose used nine gastrosopic photographs from his time with

Henning to illustrate his findings,¹⁹ he employed an amateur artist, Prosser, to illustrate his 1941 papers on the value of gastroscopy.^{20 21} The paintings are bold, with great depth and realism. These papers, which were published during the war, report on work before its outbreak, but no new pictures were published until PStartup's 13 paintings of 1945, which show the effect of treatment aimed at healing gastric ulceration. These have a grainy quality but reproduce the perspective and shadows well.²² In 1948 Dorothy M Barber's beautiful illustrations were the last gastrosopic paintings to be published.²³ Barber and her trainees illustrated endoscopic findings in many English hospitals for some decades, although very little of their work has been published.

Influences on endoscopic painting style

Although gastrosopic painting is a restricted genre, the artists had very different styles, which can be viewed as reflecting identifiable influences.

These include German expressionism (fig 3), French impressionism (fig 4A), the British artists John Piper, Henry Moore, and Barbara Hepworth (fig 4B, C) and even Frank Hampson's illustrations of Dan Dare in the *Eagle* (fig 2B).

With the increased illumination provided by modern instruments, faster film speeds, and eventually digital image capture, the intriguing variation in representation of endoscopic findings that artists provided has vanished, but for several decades science and art intersected with striking results.

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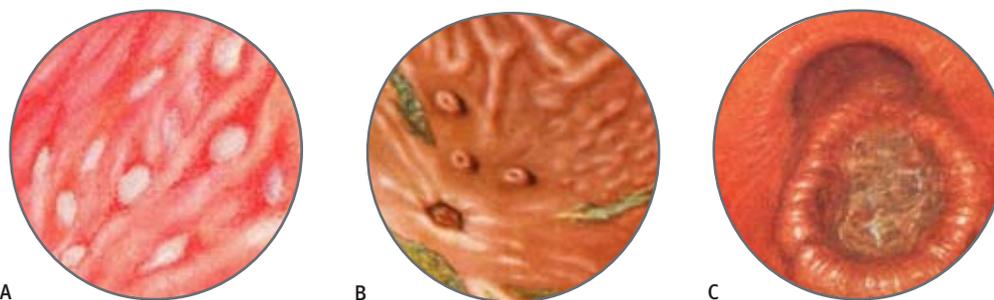


Fig 4 | Aphthoid gastritis by Escoube (A),¹⁴ gastric erosions by Streck (B),¹⁷ carcinoma by McLarty (C)¹⁸

Push, pull, squeeze, clamp: 100 years of changes in managing labour as described by Ten Teachers

What can we learn from the ever changing fashions in obstetric care, wonder **Nasreen Aflaifel** and **Andrew Weeks**

The third stage of labour (between the delivery of the baby and the placenta) is the most dangerous time of childbirth for the mother. Many of today's obstetricians were taught that "active management" of this stage (oxytocics, early cord clamping, and controlled cord traction) was the only safe way to deliver the placenta. Recent studies have shown that although prophylactic oxytocics are beneficial, early cord clamping is of no benefit (and could be harmful) and controlled cord traction has little benefit.¹ We sought to place these changes in context through a historical study of obstetric practice over the last century.

The undergraduate textbook *Obstetrics by Ten Teachers* has been a favourite with students for many generations. First published in 1917 as *Midwifery by Ten Teachers*,² the book was renamed in 1966³ and is now in its 19th edition. Each edition is written by 10 leading obstetricians from the British Isles with the authors chosen by the senior editor. With a complete absence of references in the text, the series provides an excellent example of "eminence based" medicine and gives an insight into changes in labour ward practice over the past century.

We reviewed the regimens for different outcomes of labour between 1917 and 2011

as described in the successive editions of the books. Copies were obtained from the University of Liverpool's Harold Cohen library and from interlibrary loans as necessary.

Routine third stage management

Routine third stage management focuses on reducing blood loss and achieving rapid and complete delivery of the placenta. Figure 1 and appendix 1 show details of changes over the past century. Although uterotonic drugs (drugs that enhance the contraction of the uterine muscle) in various forms have been used ever since the first edition, the practices of early cord clamping and controlled cord traction were taught only after the "active management of the third stage of labour" package was popularised in the 1960s.

Successive authors seem to have had reservations about the practice of early cord clamping, however, and have described its use as "an option" with use of the active management package or if the baby requires resuscitation. Oddly, the first mention of its routine use appears in the 2011 edition, just as national and international evidence based guidelines were dropping it as part of their recommendations, demonstrating the well recognised disconnect between "evidence based" and "eminence based" medicine.

The treatment of atonic postpartum haemorrhage

Atonic postpartum haemorrhage is the most common cause of bleeding after childbirth and results from poor contraction of the uterine muscle. See appendix 1 for details of its management since 1917.

The Ten Teachers series has always taught that uterotonic drugs are the best initial treatment for atonic postpartum haemorrhage. The standard drug has been ergot, but other early options included transabdominal intramyometrial ergometrine (1961-72) and oxytocin (1948). From 1995 onwards the choice of uterotonic drugs increased to include intravenous syntometrine, oxytocin infusion, prostaglandin F2α (intramuscular or directly into the uterine muscle), and misoprostol.

Aside from drug treatment, uterine massage (sometimes in combination with squeezing the uterus through the abdominal wall) has always been taught as the first line non-drug intervention. Early alternatives include a 180°F intrauterine douche with Dettol (a liquid antiseptic and disinfectant containing chloroxylenol) in 1938-42, and external or intra-abdominal aortic compression. The importance of bimanual uterine compression has increased gradually, moving from third to first option over the editions. Throughout the century, the importance

	1917	1920	1925	1931	1935	1938	1942	1948	1955	1961	1966	1972	1980	1985	1990	1995	2000	2006	2011			
Drugs	Ergot (oral, in a wine-glass)																					
	Ergot (hypodermic injection)					Ergometrine (im)																
								Oxytocin (im)		Ergometrine (iv)												
											Syntometrine (im)											
													Oxytocin (im)									
Placental delivery	Maternal effort																					
										Cord traction												
											Brandt-Andrew method											
																Controlled cord traction						
Cord clamping	After baby cries vigorously and pulsation stops																					
													Early in active method or if resuscitation needed				Delayed		Early			
Position of baby											Below the placenta		Same level as the placenta				Between mother's legs					

Fig 1 | Routine third stage management of labour (im=intramuscular, iv=intravenous)

of its early use was emphasised in the event of severe bleeding.

Hysterectomy is usually kept as last resort and was not even mentioned as an option until 1966. Several physical methods have been taught to try to avoid it. Early editions (1917-35) suggested packing the uterus. This technique returned in the 2000 edition along with balloon tamponade and arterial embolisation as alternatives to arterial ligation. In 2011 uterine compression sutures were also recommended as a further alternative to hysterectomy.

Retained placenta

The avoidance and treatment of retained placenta, where the placenta remains undelivered for 30-60 minutes postpartum, is a key part of third stage management. See appendix 1 for details of changes over the past century. From 1917 to 1955, the teachers recommend massaging the uterus until it is firmly contracted and then squeezing it repeatedly over five minutes to expel the placenta. If this failed, the last resort was to manually remove the placenta under general anaesthesia, but the teachers warn of the high risk of complications, including death from sepsis. Between 1935 and 1942, the use of an injection of saline into the intraumbilical vein was also recommended before any attempt at manual removal of placenta. In the latest editions (2000-2006), little discussion has been devoted to this subject, except to say that manual removal of placenta is the treatment of choice.

Delivery of a placenta that is already separated but retained within the lower segment of vagina has been discussed throughout the editions (except 2011). Until 1980, the recommended treatment was to push down on the fundus of the uterus so that the uterus acted as a piston against the placenta and expelled it. The editions from 1961 to 1995 also described cord traction as an option to deliver the separated placenta (replaced by the Brandt-Andrews method from 1972).

Discussion

The Ten Teachers collection provides an intriguing insight into the history of medical care in pregnancy throughout the past 100 years. Although only a snapshot of the teaching from a single textbook, it has provided us with the opinions of some of the most respected obstetricians of their day. It is therefore likely to be representative of medical student teaching generally at that time, especially in the first half of the century when Ten Teachers was one of few textbooks available.

Ebb and flow

An examination of a century of practice provides us with three lessons. Firstly, with scientific evidence absent for much of the century, the man-

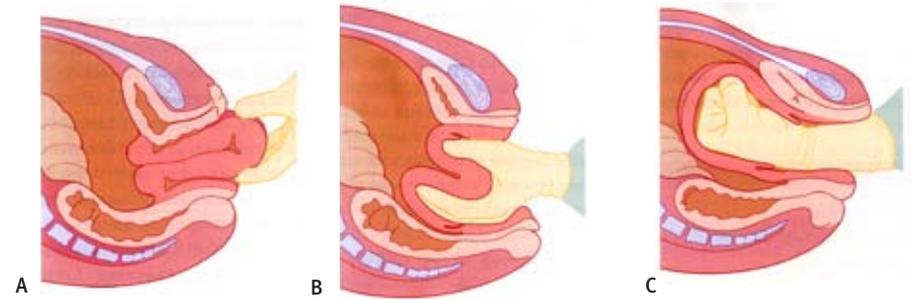


Fig 2 | Treatment for uterine inversion from latest edition of Ten Teachers

agement practices have tended to ebb and flow according to the experts' opinion and cultural acceptability. This is most clearly seen with the use of controlled cord traction for routine delivery of the placenta and umbilical vein injection for retained placenta. The recommendations regarding the timing of cord clamping, however, are also of interest. Throughout the century, right up until the latest edition (2011), teachers have taught that the cord should usually be clamped only after the baby stops crying and the cord stops pulsating (although the option of early cord clamping was introduced in the 1960s as part of the active management). This teaching persisted up to the most recent edition, when the teaching changed and students were taught to clamp the cord early. This is ironic given that it comes just at a time when there is a widespread change back to delayed cord clamping, led by guidelines from the World Health Organization, International Federation of Gynecology and Obstetrics, and Royal College of Obstetricians and Gynaecologists. Thus, though the chapters pay lip service to evidence based medicine from the 1980s (by providing a further reading list), the textbook's recommendations are not always in line with the latest evidence. This could reflect the age of the "eminent teachers" as well as the opinion that undergraduate teaching should reflect expert's practice rather than the regularly changing latest evidence.

Lowered threshold for invasive procedures

Secondly, the change in teaching clearly shows a lowering of the threshold for invasive treatments. As safer anaesthetics and antibiotics became available, so invasive treatments could be introduced at a much earlier stage. For example, with a retained placenta, students were initially taught to try to avoid the manual removal of the placenta at all costs because of the danger of perforation and death from sepsis. With antibiotics reduced and surgical morbidity, however, there was a lowering of the threshold for intervention such that manual removal went from being a fourth line treatment in the 1930s to first line from the 1960s onwards. This coincided with the dramatic reduction in maternal deaths in the United Kingdom in the 1940s and shows the greater confidence

of obstetricians in their ability to prevent surgical complications. The same is true of hysterectomy for severe haemorrhage. This was not mentioned in the first half of the century, presumably because mortality from the surgery was so high that it was not worth attempting in a woman who was already severely shocked from haemorrhage. In the 1966 edition, however, it was introduced as a possible lifesaving operation. This was made possible only with the introduction of blood transfusions, a technique that allowed women to be resuscitated before this high risk surgery.

Rediscovering the wheel

Finally, several recent "innovations" are found to simply be rediscoveries of old technologies that have been used successfully in the past but went out of fashion. This is seen with the use of amyl nitrate for retained placenta, which was recommended until 1990 but discarded thereafter. It is only in recent years that the technique (with intravenous or sublingual glyceryl trinitrate) has been the subject of high quality randomised trials that have shown that it might be both safe and effective after all.⁴ It is soon to be further investigated in a large randomised trial in the UK. The same is true for "delayed" cord clamping as outlined above and uterine packing (although the tamponade is usually done now with an intrauterine balloon). This phenomenon is not uncommon elsewhere in maternity care, with progesterone (to prevent preterm labour) and the transcervical Foley catheter (for the induction of labour) being other recent examples where "outdated" interventions have been rediscovered. As medical researchers, we could do a lot worse than to explore historical texts to see what techniques and treatments have been discarded a little too hastily. Does anyone fancy working with us on a randomised trial of the intrauterine Dettol douche?

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Bringing surgical history to life

Roger Kneebone and **Abigail Woods** describe how a surgeon and a medical historian set out to capture a disappearing world

Things change fast in surgery. Within a single generation, ways of operating that had been stable for decades have been overturned. New drugs have revolutionised what were once “surgical” conditions, and minimally invasive procedures have driven many “open” operations to the verge of extinction. As surgical teams from an earlier generation retire or die, their collective memory of surgical practice is being lost. This article investigates whether it is possible to preserve such expertise for future reference, using simulation to re-enact operations from the past.

The method

We start with open cholecystectomy—a standard operation 30 years ago, but now almost always performed laparoscopically. At first sight it may seem relatively simple to recapture such a procedure. Surely the surgical texts that trainees used at the time will provide step by step descriptions of the procedure. But the picture such sources paint can be highly misleading. Like medieval recipe books, surgical textbooks and journals assume a huge amount of contextual knowledge in their readers. “Take three quails and prepare as usual” spoke volumes in the 1500s, but such directions do not help today’s cook.

The same can be said for film, video, and even verbal descriptions of operations by those who used to perform them. Such sources privilege the surgeon’s viewpoint, while ignoring the contributions of assistants, scrub nurses, anaesthetists, and other members of the surgical team.

To capture this unspoken context, we brought together retired surgical teams and invited them to re-enact operations that they used to carry out together—like the Rolling Stones coming together again for a concert. Instead of asking our teams to perform surgery on actual patients, we used simulation.

One of us (RK) has developed contextualised simulation to create realistic operating theatre environments.¹⁻³ Designed originally for surgical training, this approach combines clinical teams with key perceptual cues (instruments, equipment, and authentic sounds) to evoke a powerful sense of taking part in an operation. Realistic models integrate silicon based prosthetic models with biological material (cadaveric animal organs) to re-create specific procedures. Participants find the experience highly convincing.⁴

The case study

We chose to re-enact the performance of open cholecystectomy in 1983. As the fourth most common general surgical operation at that time, this procedure had changed little since the early 20th century. Usually straightforward to perform, cholecystectomy was staple fare for surgeons at all levels of training, although at times it could tax the skills of the most experienced operator.

Two venues were selected: the London Science Museum and the distributed simulation inflatable operating theatre at Imperial College London (a low cost portable simulation environment).

The first step was to simulate a realistic operating theatre environment from 1983. Here



Surgical legend Harold Ellis passes on some tips

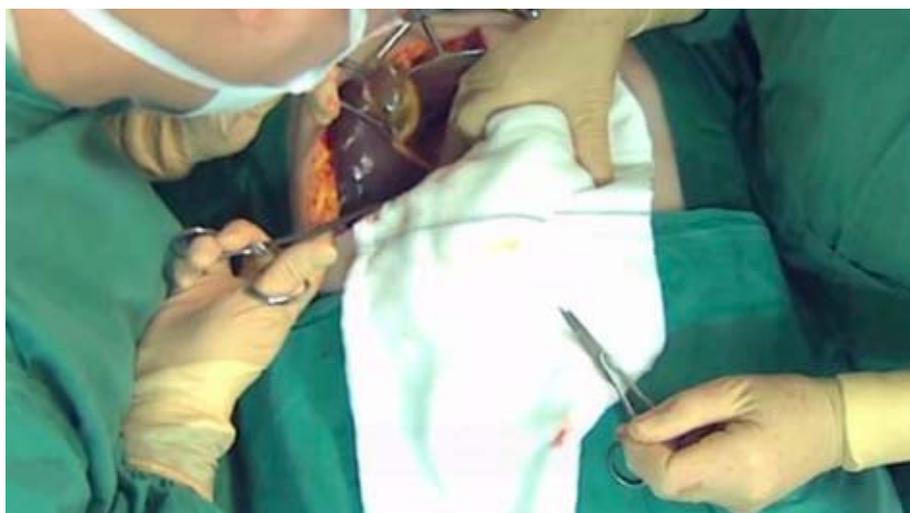
the Science Museum’s lower Wellcome gallery provided a unique resource. Created in 1980 and unchanged since then, it features a full scale operating theatre equipped with instruments, operating table, lamp, and anaesthetic machine. Other relevant information on layout, equipment, consumables, and staff was obtained from interviews (19 in-depth interviews by RK with retired surgeons, anaesthetists, and theatre nurses); textual sources (including journal articles, serial editions of standard surgical textbooks, and historical sources⁵); photographs of operating theatres; artefacts (private and museum collections of surgical equipment and instruments); film and video (including 1983 teaching videos of cholecystectomy and laparotomy by Harold Ellis); drama and documentary material (BBC); and personal recollection (RK was a surgical registrar at the time).

We then developed a custom built hybrid cholecystectomy model, positioning a cadaveric porcine liver and gallbladder within a realistic silicon abdominal cavity. Team members were garbed, gowned, and gloved appropriately, and we took great care to create a sense of realism. A 1980s anaesthetic machine (including Manley ventilator) was augmented by recorded sounds.

Through personal contacts we recruited two “senior” surgical teams, each with enormous experience of operating and teaching.

Senior team 1 included Harold Ellis (surgeon; HE) who qualified during the second world war and is well known to generations of surgeons and medical students as an iconic teacher and clinician. The other two members of the team were Stanley Feldman (anaesthetist) and Mary Neiland (theatre sister), who worked with Ellis for decades at Westminster Hospital, London until he retired from clinical practice in 1989.

Senior team 2 represented a later generation: John Black (surgeon; JB), Bruce Roscoe



Lifelike appearance of cholecystectomy model



bmj.com/multimedia
Behind the scenes
at a re-enactment
▶ bmj.com/multimedia

Where next?

So far as we are aware, this is the first attempt to document recent historical practices of surgery through re-enactment by clinicians who were there at the time. Our findings reveal that despite some obvious limitations (not least the absence of a real patient), simulation has the capacity to capture not just past surgical techniques, but tacit and embodied behaviours, and social ways of working that elude capture by other means.

The practices we have captured are not only of historical interest. They exemplify vanishing skills which may prove of real importance for present day surgeons. For example, if it becomes necessary to “convert” during a laparoscopic gallbladder operation (as still happens occasionally if complications arise), a new generation of surgical consultants can no longer draw on years of experience of open surgery to get them out of trouble. The same is starting to happen in many other branches of surgery, where open operations are fading from collective memory and expertise is being swept away. Examples include urological procedures and operations for upper and lower gastrointestinal cancer.

Of course not everything that is old should be preserved, and some practices are better abandoned. But knowing which to keep and which to discard is not easy. We argue that documenting vanishing surgical practices may prove more valuable in the future than we now appreciate.

As well as their expertise in everyday practice, our senior teams have lived through—and contributed to—many extraordinary advances and upheavals in 20th century surgery. Yet our access to this wealth of shared experience cannot last forever, and soon it will no longer be possible to reconstitute full teams from long ago.

“The past is a foreign country: they do things differently there.”⁶ LP Hartley’s famous first line from *The Go-Between* sums up the challenge of capturing a vanished time.

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(anaesthetist), and Julia Radley (theatre sister) worked together for decades in Worcester until Black retired from clinical practice in 2006 (becoming president of the Royal College of Surgeons of England in 2008).

Each session re-created a “routine operating list,” headed by the consultant surgeon and assisted by current surgical trainees (aged about 30 years). The consultant performed one operation as primary surgeon then helped one of his trainees during a second case. All procedures were recorded in high definition using multiple static and roving videocams with sound. Footage included activities of the whole surgical team and close-up details of the operative field. Participants (including surgical trainees) took part in a recorded debriefing after each operation, and senior teams were followed up by subsequent interview.

What we found

Both operating teams became fully immersed in the operation. Participants quickly suspended disbelief and assumed their customary roles as clinicians and teachers. Although subsequent interviews identified certain aspects of the simulation as unrealistic, both surgical technique and teaching style closely reflected ingrained practice. In both teams the anaesthetist and theatre sister commented on how true to life the surgeon’s behaviour appeared, and vice versa.

Operations in which trainees operated under supervision proved especially valuable. Here, surgeons verbalised ways of working that long experience had made subconscious and automatic for them. Their instructions and guidance, issued in everyday language, went beyond the specific technique of cholecystectomy to include more general “nuts and bolts” of surgical practice: how to improve exposure within the operating field; how to hold, position, and use instruments; and how to handle and dissect tissues. In one case the scrub nurse helped provide this information.

Surgeons included tips from their own experience, summarised different schools of thought, gave accounts of what might go wrong, and provided instruction on how to anticipate and manage difficulties. In this way, simulation allowed experienced clinicians to articulate and share their experience with today’s trainees, handing down age old techniques of manipulating instruments, developing tissue planes, anticipating complications, and avoiding mistakes. The trainees greatly valued the opportunity to learn in such tactile non-verbal ways (box, bmj.com).

Simulated re-enactment also provided valuable social insights into how members of long established surgical teams worked together. Their interactions were marked by banter, requests, and queries.

We also found many examples of non-verbal unconscious interaction, such as the recognition of cues that indicated different phases in the operation, the unprompted selection and passing of instruments between theatre sister and surgeon, and the physical positioning of team members in relation to each other. The result was a seamless mode of working, in which team members anticipated each other’s needs and responded collectively to the situation as it evolved. When invited to review the video recordings after the procedure, team members were able to identify behaviours of which they had been unaware at the time.

This is an important finding because such ways of working are disappearing. The introduction of working time restrictions has spelt an end to stable “firms” with their “institutional memory” of collaborative skills. Today’s ephemeral groupings can no longer rely on wordless understandings gained through years of working together. In demonstrating the importance and operation of such understandings, the value of simulation goes beyond the capture of surgical techniques, to include entire ways of working within the unique space of the operating theatre.