The dawn of a new century

Reflections on surgical issues

Much progress in surgical treatment has been achieved during the last century, which saw the birth of endoscopic surgery. It is important for us to build on this achievement, but equally we have to adapt to a rapidly changing situation that will affect all specialties involved in the delivery of health care, and surgery is no exception. There are considerations that relate to the process of medical care, how it should be delivered more effectively, and how we assess outcomes and performance. There is no doubt that the days when it was acceptable for the medical profession to self-regulate its performance are over. Patients are now much better informed through access to the Internet and WWW (World Wide Web). Furthermore, many societies and governing bodies require or are about to introduce compulsory measures that provide evidence of effectiveness of the health care delivery, and continued competence of the individual physician throughout his or her career, although it has to be said that assessing competence of medical practitioners is easier said than done.

All of this has to be seen in light of the dramatic changes in treatment and interventions brought on by the relentless progress in technology. In this respect, one of the many essential attributes of young surgeons is adaptability, that is the ability to acquire new skills and modalities of therapy throughout their professional career. Who is to say that 20 years from now some surgeons will not be operating exclusively via a computer interface controlling a master-slave manipulator? The more senior among us have had to acquire new skills and the way we practice and operate has changed dramatically from the days of our residency training programs. There is nothing new in this process of continued professional development, which has been overshadowed by the Holy Grail of continued medical education (CME). The two are interlinked but in surgery knowledge, it is simply not enough.

What is the strategic plan?

As far as I am aware, there is none. We agree on objectives but lack a unified action plan. Perhaps it is timely that we as surgeons look beyond the confines of the operating rooms and clinics and acknowledge the need for change. There seems little doubt that patients want less traumatic treatment than conventional open surgery has to offer, and where this is possible there is now little doubt of the benefit of this approach. The last two decades of the 20th century will be judged, I am sure, as a milestone in the history of surgery. However, the minimal access therapeutic approach is not limited to surgery but also includes interventional radiology and interventional endoscopy. In some instances, surgery is assuming a secondary role to one or other of these two arms of Minimal Access Therapy. To quote a pertinent example, 80% of vascular interventions are performed by interventional radiologists with the vascular surgeon functioning as a standby observer in case things go wrong. Surely this has implications on how we should train vascular surgeons during this century. There has also been an emergence of multidisciplinary, disease-related treatment groups, certainly in the big tertiary referral centers. This is likely to become the norm and should not be seen as a threat to surgery but a unique opportunity, since surgeons have to be first among equals in these multidisciplinary groups, simply because they are the ones who have to deal with complications. Since surgeons provide the "safety net" for these interventions, surgeons ought to be the leaders of such multidisciplinary teams. To this effect, therefore, we have to change our training programs to include multiprofessional skills. To refer to the previous example, a vascular surgeon, laparoscopic or open, has to be trained in interventional radiology. The question is to what level? And how will our radiological colleagues react to this suggestion?

How do we improve performance?

It is now axiomatic, and indeed compulsory in most countries, that doctors must monitor and evaluate the quality of care they provide. From a broad perspective, the medical audit has three components: structure, process of health care delivery, and audit of outcome. All are important and determine quality assurance [3], which itself is monitored by the completeness of the audit cycle and use of critical event analysis. The audit cycle differs from mere collection of data on treated patients because it addresses the question of whether the results based on agreed outcome measures have
improved and come up to the national standards. Critical event analysis [6] is a mechanism whereby unexpected failure is discussed internally or publicly in some county, such as the UK (Confidential Inquiry), to establish events/factors involved that caused the mishap and to institute the necessary steps to prevent recurrence. In essence, therefore, it is retrospective—its nature is akin to a postmortem.

There is also a real problem if the audit of outcome in surgery does not include preoperative risk assessment scores, as the temptation will then arise for surgeons to exclude patients at risk from surgical treatment. Indeed we should insist that no comparative analyses of surgical outcome are acceptable or meaningful if the data sets do not contain information on preoperative risk scores. In this respect, preoperative risk assessment based on the ASA grading is manifestly inadequate and should be replaced by more reliable and useful assessment/scoring systems such as the POSSUM (Physiological and Operative Severity Score for the enumeration of Mortality and Morbidity), which has now been extensively validated and provides a numerical assessment of risk [9]. It allows valid comparisons between surgical units and hospitals by taking into account medical conditions, case mix, and other nonsurgical factors.

Perhaps during this century, we should move beyond audit in our quest for improving performance and outcome after surgical treatment and adopt Human Reliability Assessment (HRA), which has been used in high-risk industries as a measure of prevention of accidents, the consequences of which would be catastrophic. The techniques used borrow from expertise in three fields—engineering, psychology, and ergonomics—the ultimate aim being to reduce errors, such that the risk of the task is As Low as is Reasonably Possible (ALARP region). HRA differs from audit used in surgical practice in that it is both prospective and prescriptive from the start, that is, the methodology identifies (i) what may go wrong, (ii) the probability of this happening, (iii) the consequence were this to happen, and (iv) the necessary defense systems that need to be incorporated to ensure that the risk is in the ALARP region. The objective of HRA is to eliminate/reduce human error. Rasmussen classified human errors as:

- **Skill-based level**—relate to faulty execution of a task
- **Rule-based level**—misclassification/misdiagnosis leading to the application of the wrong rule
- **Knowledge-based level**—arising from incomplete or incorrect knowledge

From the practical viewpoint, James Reason describes two broad categories of human error: active and latent [2]. Active errors are enacted by front line operators and have an immediate effect, for example, a driver crashes the car, or a surgeon inflicts an injury to the aorta during the creation of a closed pneumoperitoneum for laparoscopic surgery. By contrast, latent errors (hidden within the system) may lie dormant and undetected causing no adverse effect until they summate to create the necessary trajectory for a major catastrophe. Many of the major disasters that could not conceivably happen, but did, for example, Three Mile Island, Chernobyl, Zeebrugge ferry, 1999 London train crash, were the outcome of latent errors related to bad decision making, bad management, faulty practice, or inadequate maintenance. In his seminal monograph on Human Error, J. Reason states, "Rather than being the main instigators of an accident, operators tend to be the inheritors of system defects caused by poor design, incorrect installation, faulty maintenance and bad management decisions." There is an exact parallel in surgical practice where a combination of latent errors are more often responsible for a fatal disaster than front line errors enacted by a surgeon during the course of an operation. There is evidence that the risk of latent errors increases with the complexity of the activity, especially if it entails the use of advanced high technology.

The generic HRA system includes a number of steps. **Problem definition** entails precise definition of the system/activity and the problem(s) that can occur and which must be avoided. In the context of a surgical operation, this may be "local recurrence" after resection for cancer, anastomotic dehiscence, infection after hip replacement surgery, and so forth. **Task analysis** is the identification of the nature of all the component steps of the activity or operation including the use of specific equipment. In surgical operations, task analysis includes the selection criteria (indications), all the component steps of the operation, all the equipment used, and the experience of the surgeon with the procedure. **Human error identification (HEI)** is a crucial component of the process. All conceivable errors that may occur during the steps of the procedure, their nature, and consequence are identified and categorized. There are various methods of error categorization but the one that is most applicable to surgery is that based on External Error Modes (EEMs) outlined in the Systematic Human Error Reduction Predictive Approach (SHERPA) initially proposed by Embrey [8]. Human error identification also includes identification of factors that influence human performance (performance-shaping factors). These are important in surgical practice. **Representation**—this step consists of modeling the human errors and the recovery paths in order to quantify their effect on the system/outcome. This process involves the integration of human errors with hardware (devices/equipment) failures in a fault/event tree. **Quantification**—in this step the probability of any given error occurring is estimated (human error probability or HEP) as well as human error recovery probability by a variety of human reliability quantitation techniques. HEP is simply derived from the number of errors encountered/number of opportunities for the error to occur. In the high-risk industry, this is simply an estimate based on a predictive analysis. In surgery, HEPs can be quantitated accurately by using an observational data capture based on videorecording of the operations. The material is then analyzed for the error rates by a surgical expert in conjunction with an ergonomist. This technique provides an accurate estimate of both procedural (interstep) and execution (intrastep) errors enacted by a surgeon during a specific operation. **Impact assessment**—at this stage, decisions are made on whether improvements in human reliability are needed with respect to the activity/system/operation. **Error reduction**—this is the remedial step when defence systems are introduced to prevent the errors and thus achieve a safe and consistent performance. In sur-