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EDITORIAL

Challenges of surgery in the 21st century☆

Retos de la cirugía en el siglo XXI

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Surgery was born with humanity itself. There are many signs of how men in the past resolved surgical problems such as fractures, infected wounds, abscesses and deformities. They used a range of surgical techniques such as cleaning and debriding infected wounds, amputations, setting fractures, reconstructive surgery and other procedures. Expert surgeons have evolved from being sorcerers, shamans, barbers, doctors without a university degree and consultants, until they became highly specialised. Although it is true that surgery advanced notably with the magnificent anatomical descriptions by Andrea Vesalius (1514–1564) in his work *De Humani Corporis Fabrica*, it has reached its peak in the last 150 years and is still growing exponentially while becoming increasingly more inclusive and complex.

It developed in this way thanks to great surgeons such as Joseph Lister, who in 1867 published his antiseptic techniques, Theodor Billroth, Johan von Mikulicz, George Thomas Morton, Charles McBurney and, in particular, William Halsted (1852–1922), who stated that ''operations in themselves are only a small part of the surgical procedure'', and concluded that ''we need a system, which we will surely achieve, to produce not only surgeons, but rather surgeons of excellence who stimulate young doctors to study surgery and commit all of their energy and life to increasing the knowledge of surgical science''.

Surgery is still fighting to become a science, constantly increasing its foundations in anatomy, physiology and pathology, while advancing in genomic and molecular findings about the complex responses it evokes: inflammatory, immunological and metabolic. On the other hand, surgical procedures are becoming less traumatic and safer. This is thanks to advances in minimally invasive surgery in all specialities, which have arisen due to major progress in the technology of ventilation equipment, instrumentation, visualisation, energy and cutting instruments. Likewise, the emergence of intensive care units, nutritional support and drugs such as antibiotics, antithrombotics and coagulants, as well as the selective use of blood and blood component replacements, have all led to the increasing successes of current surgery. This has raised important challenges for us, such as:

- Education in surgery and the acquisition of surgical skills
- Adverse events in surgery
- Quality in surgical care
- The ethical behaviour of surgeons

The large amount of medical–surgical knowledge means that we have to set different educational strategies. The knowledge which exists now is not the same as that which existed 50 years ago, in 1970. It is now said that several dozen years would be needed to read all of last year's medical texts. In the same way, 2 new medical–surgical research projects now arise every minute, and specialist doctors have to read at least 10 bibliographical references every day to keep up-to-date. The inflammatory response to surgery stands out among emerging knowledge, together

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with genomic and regenerative medicine, where knowledge increasingly centres on the molecular level. Likewise, new surgical procedures are emerging such as endoscopy, laparoscopy, robotic surgery, NOTES (natural orifice translumenal endoscopic surgery), and interventionist radiology, while remote surgery is also advancing. New educational strategies are under investigation too, with the aim of teaching in a more thoughtful, critical and responsible way in which students' independence is fundamental. The following new educational strategies stand out:

- Student-centred teaching
- Skill-based study plans
- Problem-based learning
- Evidence-based medicine
- Basic-clinical integration
- Medical computing and
- Remote medicine.

All of this has to be ordered to create surgeons who question, analyse, decide and act in favour of their patients, supported by a science-based working discipline. They will thereby be able to offer surgical care using the best evidence, in the knowledge that research is needed to generate this. They will be aware that although they will often have to work without evidence, they will do so on the basis of their experience, good clinical judgement and correct decision-making. Modern surgeons must also aspire to hold a doctorate or master's degree which will allow them to undertake clinical or experimental medical research.

To acquire surgical skills and dexterity it is desirable to use simulations. This educational methodology makes it possible to reproduce real situations in a controlled environment, to improve professional skills, communication, coordination and leadership, and psychomotor deftness above all. This way of learning aims to satisfy the neurobiological needs that are essential in gaining manual skills, such as repetition, visualisation, motivation, commitment, responsibility, active participation and dealing with stress and fatigue. The acquisition of skills and dexterity by means of simulation should involve the educational principles of Fitts and Posner:

1. The cognitive stage, in which the foundations of the skills to be developed are explained
2. The inclusive stage, during which movements and skills are repeated as often as is necessary until they are performed correctly, and
3. The autonomous stage, in which movements and skills reach perfection when performed automatically.

Simulation has the following main objectives:

- To increase students' skills and thereby increase their self-confidence when working with patients
- To fulfil the requisites set by the academic curriculum without having to wait for specific types of complaint to present
- To standardise surgical procedures, and
- To repeat practice as often as necessary.

Its benefits therefore include:

- Working in a controlled environment
- There are no adverse consequences for patients
- Errors are permissible and students are able to plan and correct them
- The learning curve is shortened, and
- Operating theatre resources are optimised and saved.

It is possible to implement simulation with non-biological models (mannequins or virtual models) or biological ones (animal segments, live animals, inert human material). There are no good or bad simulators, as they all offer benefits, so that the selection of a simulator depends on the specific learning objectives.

Advances are also taking place in the acquisition of theoretical and practical knowledge. Better tools for this are now available, such as computerised examinations, structured objective evaluation, evaluation by portfolio or more objective parameters. There are now computer programs which record manual dexterity and offer a record of the movements made. At the same time mathematical tests can be used to measure two-handed dexterity, length of trajectory, depth perception, smoothness of movements and velocity. This makes it possible to distinguish between new, intermediate and expert students. It is important to state that, in this educational strategy, students also learn new surgical procedures and become familiarised with instruments as well as state-of-the-art surgical equipment. The major challenge now is to achieve teaching that is interactive, participative, committed, well explained and in small groups, all coordinated by a tutor. Students must also be supported by educational strategies using simulation in their acquisition of surgical skills and dexterity. As Ziv points out, this will lead to an ethical teaching and learning process in which patients are protected, as they are not used in learning.

Efforts to correct educational strategies arise due to the detection of areas of weakness in the training of interns. The adverse events which arise in medicine and most particularly in surgery are doubtless of great concern. This was emphasised by the publication of the report ''*To err is human*'' (1999), which stated that adverse events were the eighth cause of death. Now, 15 years later, they are the third cause of death. Surgical techniques must be procedures that lead to patient well-being and health. Nevertheless, sometimes and in spite of applying all of the relevant guidelines and norms, we find that in surgical practice unforeseeable, unpreventable or inevitable adverse events may occur. Due to this there are a series of programs that aid safe surgery, not only through the good performance of techniques, but also through good communication and working of the surgical team. Surgical safety commences in the preoperative stage, when patient identity, the site of surgery, procedure and consent must all be confirmed. Anaesthetic technique must be sufficient to ensure that it is safe and free of complications, with awareness of any pharmacological allergies or avoidable haemorrhages. The procedure to be used must be confirmed in the postoperative phase, together with the correct count of instruments, gauzes and needles, with proper labelling of the biological samples obtained and records of whether any problems were detected in

instruments or equipment. These simple measures are fundamental for patient care and even survival. On the other hand, we are convinced that an adverse event in medicine arises due to multiple factors: the disease in question, the surgical team (surgeons, anaesthetist, theatre nurses, therapist doctors, etc.), type of hospital, instruments and state-of-the-art surgical furnishings, etc. The challenge is to learn the different causes that led to adverse events, ensuring that their type and cause are reported so that it is possible to learn from mistakes and train those involved to reduce the occurrence of adverse events. In principle this should not require disciplinary measures but rather the correct training of personnel, perfect equipment in hospitals, reference and counter-reference to the patient and the right to universal care, as well as application of the guidelines and norms for safe surgery.

Parallel to the above developments, many studies also describe intern exhaustion, stress and lack of sleep. These cause them to suffer alterations that give rise to deficient cognitive learning and manual skill acquisition, psychological alterations (bad moods), marital problems, drug abuse and up to one third more medical errors. They are also twice as likely as their social counterparts to suffer a traffic accident. Therefore, as well as adjusting educational strategies, intern workloads are now being reduced. This is why the Accreditation Council for Graduate Medical Education has reduced interns' working week to more than 80 h, with no more than 30 h on call and at least 10 h rest afterwards. In other countries their working week has been reduced to 64 h in the United Kingdom, 52.5 h in France and 37 h in Denmark. The challenge is to offer interns a higher quality of life while they train as surgeons.

Medicine and surgery require the coming together, communication and comprehension of the patient–doctor couple. Given their suffering patients place their trust in the doctor and offer their body so that the surgeon can treat the existing surgical disease. Surgeons therefore have to respond to this praise with knowledge, skills and adroitness, clear communication, assertive decision-making, confidence and solidarity. This human contact is as valuable for patients as the care of a surgeon with surgical knowledge and skills. These characteristics are indivisible. It is of fundamental importance for all surgeons to keep to their ethical and bioethical principles during their whole life, and these have to be strengthened or taught from the first in medical education, and their teacher must be an example of this.

There is currently a discussion about whether there is any weakness in the quality of care offered by surgeons, or if they lack interest in continuous training, qualification and human treatment for patients. It is therefore still valuable to encourage students respecting the attitudes of responsibility, honesty, humility, respect, professionalism, self-criticism, humanism, altruism, discretion, tolerance, leadership, social solidarity and the protection of their surroundings and the environment.

Due to all of the above considerations, we cannot retreat but must advance towards the generation of Scientific Surgeons, who are distinguished by:

1. Maintaining a solid academic education
2. Seeking the truth in medicine and surgery
3. Basing themselves on scientific method
4. Developing clinical and basic research for application to surgery and generating proofs
5. Generating schools of surgical knowledge and research
6. Being innovative and creating patents
7. Studying for their whole life
8. Governing themselves by ethical and moral rules
9. Being committed to patients, society and themselves
10. Being a leader.

To summarise, we can say that surgery is becoming increasingly less traumatic and mutilating, more anatomical and functional, and above all that it is safer. Nevertheless, we have to face the challenges described above without forgetting that in spite of the major technological advances, clinical care, communication, solidarity and the ethical and humanistic management of our patients are the fundamental pillars for the progress of surgery.