The “Changing Face” of Surgery

Editorial

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Half a century ago, the prospect of man setting foot on the moon was a figment of a cinema director's imagination. Incredibly, in 1969 it became a reality. Likewise, had anybody at that time predicted the changes about to be witnessed in surgery, they too would have been relegated to the realm of science fiction. Yet, several new instruments and biotechnical concepts have been introduced since then that have served to radically change the face of surgery and the approach to many surgical diseases.

Prof. Basile Kourias (1901-1993), an eminent Greek surgeon, tended to take a philosophical view when examining the current problems in surgery in depth. In early-70s, possibly influenced by the advent of CT scanning and its diagnostic potential at the time, he was quoted as saying “this is the changing face of surgery.” Today, that “changing face of surgery” remains an ongoing process and provides the title for our editorial.

Fundamental changes in surgery do not occur every day. Surgeons, both old and young, operate according to the way they were taught during the years of their specialisation and usually continue doing so throughout their surgical career. Along the way, they add their personal experience, skill, talent and individual achievements, all of which contribute to the progress and continuous evolution in surgery concerning rates of mortality, morbidity and success.

The evolution of medical technology has strongly influenced surgery. One such example is the expanded use of staplers in peptic surgery that has shortened the operative time and improved the quality of the anastomosis, providing far better results [1].

The mid-70s saw the advent of ultrasound application [2] and axial computed tomography [3] heralding an explosion in the advancement of imaging modalities. The computerized tomography cross-sectional imaging technique provided diagnostic ra-

diology with a better insight into the organs inside the body. In 1979, G.N. Hounsfield and A.M. Cormack were awarded the Nobel Prize in medicine for the invention of computed tomography (CT). With the aid of CT it became possible for the first time to produce non-superimposed images of an object slice, while the new term “preoperative staging” began to be used for cancerous conditions. Since then, we have witnessed the development of endoscopic ultrasound sonography [4], endoscopic magnetic resonance imaging, [5] extending to the endoscopic use of digital angiography, and positron emission tomography. PET scanning images demonstrate the chemistry of organs and other tissues such as tumours. A radiopharmaceutical, such as FDG (fluorodeoxyglucose) that includes both sugar (glucose) and a radionuclide (a radioactive element) to give off signals, is injected into the patient, and its emissions are measured by a PET scanner [6]. All of these developments have changed the surgical approach to the patient and their contribution to timely diagnosis and treatment has helped to prolong mean life expectancy.

Occasionally, changes in surgery can appear quite suddenly and not last for long or not be accepted by the majority of surgeons. In 1971, at the 24th World Congress of Surgery in Moscow, Denton Cooley from Houston Texas presented his experience of replacing the mitral valve in cardiac surgery with the “Wada” valve which was flat and took its name after the Japanese cardiac surgeon Wada [7]. His series included more than 400 cases. Cooley answered many questions after his excellent presentation, one of which was asked by a Japanese surgeon, in rather poor English. “Just a moment” interrupted Cooley, “I don’t understand your question. Who are you? What’s your name?” And the answer was: “I am Dr. Wada”.

The majority of cardiac surgeons found the Wada valve difficult to accept and so continued to apply conventional spherical valves for several years. This is just one, but by no means the only, example that was not generally accepted by the surgical community.

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In contrast, subtotal gastrectomy with gastrointestinal anastomoses, as well as selective vagotomy or truncal followed by pyloroplasty continued for many decades to be the operation of choice for duodenal ulcer worldwide. In 1987, participants at the 32nd World Congress in Sydney witnessed a huge change, as presented by Australian gastroenterologists. They insisted that *helicobacter pylori* were the cause of duodenal ulcer and that administration of antibiotics solved the problem [8]. Given that the ulcer disappeared, as did its major three complications including hemorrhage, perforation and pyloric stenosis, gastric surgery for ulcer was abandoned. Since then, gastrectomy has been reserved only for gastric malignancies. Marshall & Warren "re-wrote" the text-books with reference to what causes gastritis & gastric ulcers as well as to what would be the appropriate treatment for peptic ulcer. In recognition of their very important discovery, they were awarded the 2005 Nobel Prize for Medicine & Physiology. What a monumental change!

Another impressive development in the 80s was the evolution in the perfection of endoscopy with flexible endoscopes. The diagnostic armamentarium has been greatly enriched as a result and its potential in endoscopic surgery is immense. Nowadays, every cavity and organ can be visualized by an endoscopist, including even the most distant areas such as the small bowel; it has enabled such procedures as push enteroscopy. Capsule endoscopy is yet another innovative procedure that involves a miniature capsule recording images through the digestive tract for use in medicine. The capsule contains an imaging system, usually a camera, with the size and shape of a pill used to visualize the gastrointestinal tract. The procedure was approved by the U.S. Food and Drug Administration (FDA) in 2001. This imaging device facilitates the diagnosis of diseases and disorders of the gastrointestinal tract. The endoscopy capsule has solved many problems in the pathology of small bowel especially in obscure bleeding of gastrointestinal tract as well as push enteroscopy [9, 10].

In the early 90s we experienced a further "revolution": "minimally invasive" or "image-guided" surgery. Laparoscopic cholecystectomy and a large spectrum of laparoscopic interventions, involving the esophagus, stomach, pancreas, small and large intestine, adrenals and almost every other intra-abdominal organ, rapidly became the access of choice. Older surgeons, who initially disputed laparoscopic surgery, finally accepted the new method. Better exposure of the intra-abdominal viscera, along with improved results and very low mortality and morbidity, counted amongst the irrefutable advantages.

In the knowledge that it incurs less pain, reduced risk of infection, shorter hospital stay, immediate ambulation, less postoperative complications and earlier return to work, increasingly more patients are "demanding" a laparoscopic solution, even when contraindicated. An added benefit lies in that it is also a cost-effective method [11, 12].

The main concern was that laparoscopic cholecystectomy "ignored" the pathology of the common bile duct. As we all know, biliary surgery refers mainly to extrahepatic biliary ducts and common bile duct. During his term at Hammersmith Hospital of London, L. Blumgard once addressed, the members of the Hellenic Surgical Society at that time saying "So what? What does it matter if you leave behind a stone or if you later diagnose a new stone? Nowadays, the common bile duct is accessible through "ERCP."

Coronary revascularisation using cardiopulmonary bypass remains the gold standard treatment for coronary artery disease. The method of venous autografts to bypass obliterated coronary arteries has witnessed a spectacular expansion during the last thirty years. Over the past decade, techniques of revascularisation on the beating heart without the use of cardiopulmonary bypass (off-pump surgery) have evolved in an attempt to reduce the potential deleterious effects of extracorporeal circulation [13].

Today, coronary stents for percutaneous interventions have replaced the cardiopulmonary bypass in the majority of cases. In fact, the expansion of "stent technique" has become the treatment of choice for many diseased large arteries such as carotid artery, aorta etc [14]. All the above have contributed to the changing face of cardiac surgery.

Biotechnology has become very important to all surgical fields, highlighting new achievements. We have all experienced how rapidly each change is succeeded by a newer one. This explosion of technology and expansion of new techniques and methods in every field of surgery reveals many points of interest: It is not feasible for an older surgeon to be taught and educated in new operative and interventional surgery. They cannot operate independently, without the active presence of an experienced young assistant, already specialized. This is not a question of willingness and ability. It is a fact of weakness and a lack of self-assurance and self-confidence.

Seventeen years ago, I was invited to attend a laparoscopic cholecystectomy. Despite the presence of the older surgeon, who was responsible for the operation, I realized that the whole procedure was to be carried out by his assistant.

It is a fact that most surgeons, as they approach the

end of their "surgical life", become conscious of the reality that they are not able to digest all the "nouveauautés" in surgery: staplers, ERCP, laparoscopic surgery, stents abound, inserted aortic grafts etc.

New educational methods in surgical training are based on virtual reality simulation and the so-called guided-image training surgery [15]. These methods have a particular value in laparoscopic surgery, as they can enable new surgeons to overcome any difficulties presented by laparoscopic access. The development of this software and its application has become an integral part of the educational procedures of novice surgeons. Two other recent developments in surgery should also be mentioned, namely robotic surgery and natural orifice trans-luminal endoscopic surgery (NOTES). Robotic surgery has already been included in daily practice with impressive results, though there are reservations concerning its cost. Some major advantages of robotic surgery include precision, miniaturization, smaller incisions, decreased blood loss, less pain, and quicker healing time. Further advantages are articulation beyond normal manipulation and three-dimensional magnification [16, 17]. The Da Vinci Robotic Surgical System offers all the afore-mentioned advantages. The last four years or so have even seen the development of so-called "incisionless surgery," (natural orifice transluminal endoscopic surgery, or NOTES), in which even the tiny incisions used for laparoscopy are missing. Endoscopic instruments similar to those of laparoscopy are introduced through the rectum, vagina, or stomach (natural orifice) [18]. I have to admit, I cannot yet see the utility of NOTES, given that laparoscopy incisions are already very small, and the introduction of instruments through the oesophagus, rectum or vagina would most likely increase the risk of infection, mainly because it is impossible to completely sterilize the mouth, rectum, or vagina. NOTES is surrounded by controversy as it poses several questions of ethics. We have to wait for better decision making both from the surgical community and the patient. It is necessary and urgent to adapt surgical education to these new methods and techniques for young surgeons. Education has to be designed and planned by a central "educational point" of the State or Surgical Societies.

To this end, strong relations and exchange programs have to be scheduled and established between surgical centres and departments worldwide, among those medical Clinics that promote new technologies and techniques. It is equally vital that young surgeons know how to perform a conventional open cholecystectomy and deal with biliary

branches and mainly how to open the common bile duct or undertake a subtotal or total gastrectomy, clearly reserved for cases of tumours and malignancies. It is also essential to remember that there is a 5% conversion rate of laparoscopic to open surgical procedures when objective difficulties impose this conversion.

Congresses have adapted to these new changes. Medical bulletins and surgical books and magazines have changed their focus. The Internet has proved an undeniable source of recent and valuable data. Problems of previous years, as well as points of great surgical interest and face-to-face debates, are no longer considered as important. Surgical technology, methods of surgical intervention and minimally invasive surgery form the subject of new interest. This editorial would not be complete without a reference to two absolutely different fields of surgery: trauma and organ transplantation. The management of a patient with trauma has dramatically changed with impressive results in survival. New guidelines for Advanced Trauma Life Support (ATLS) and another view of the underlying pathophysiologic condition have led to innovations in surgical management of the patient with serious trauma such as the new surgical strategy known as "Damage Control Surgery" [19]. Another characteristic example is the change that has evolved in the surgical management of liver injuries, 90% of which are no longer explored surgically.

A further advancement of our era is the technique of sentinel lymph-node biopsy which detects and dissects the first node which is most likely affected by breast cancer, which if proved negative for tumour involvement, can spare the axilla of complete lymph-node removal, thereby reducing morbidity, numbness, paraesthesia of upper arm and lymphoedema. The technique also allows a more accurate staging of the axilla. Pathologists can examine closely by serial sectioning one or more of these important nodes which are most likely to harbour metastasis, and perform immunohistochemical staining. This technique has completely altered surgical strategy in breast cancer, in line with the improvements made in preoperative assessment. Triple assessment is the main tool in diagnosis in breast cancer. This includes physical diagnosis by the clinician, imaging diagnosis through ultrasound and/or conventional mammogram (nowadays, digital mammogram), and cytological diagnosis by fine needle aspiration or core needle biopsy (mammatome). If any one part of the triple assessment raises suspicion, the breast lump should be removed. Early diagnosis of breast cancer and the increase of DCIS (Ductal car-

cinoma in situ) incidence are the result of the new diagnostic approach in breast cancer and the result of mass screening mammography [20].

During recent years, a new concept for management of morbid obesity has prevailed with the implementation of "Bariatric Surgery". Many of our fellow-beings can hope for a better future due to the impressive results. This field of surgery that currently involves open or laparoscopic techniques (and will soon include endoscopic methods), with restrictive or predominantly malabsorptive or mixed procedures, constitutes a real evolution, further changing the face of surgery [21].

Finally, the impressive evolution and progress recorded daily in the field of organ transplantation is also changing the face of surgery. Broelsch First in 1989 [22] performed the first living related donor liver transplantation in a child in Chicago, while in 2005, a Greek surgeon named Andreas Tzakis, a pioneer in this field, published a hundred multivisceral transplantations [23]. This advancement constitutes an indisputably major breakthrough.

I would like to finish my editorial with references to two up-to-date evolutions simultaneously real and imaginary. The first one is anticipated to develop from the research into stem cells. Stem cells, the building blocks of our bodies, could grow into any of the tissues that make up our bodies, including bone, muscle, skin, brain cells, heart cells and those of our organs, so repairing tissues and organs. If scientists could harness and direct the pluripotentiality of stem cells, new ways would be found to study diseases and even make "new body parts" replacing damaged tissues. This fantastic evolution will be nothing short of a revolution, completely changing the face not only of surgery but of all medicine [24].

The second up-to-date evolution is nano-surgery. Nano-surgery could well be the next surgical revolution [25]. Nanorobots may soon navigate the human body. Nader Jalili, an associate professor of mechanical and industrial engineering at North Eastern University, is working to create a controlled nanorobot that will be capable of performing non-invasive cancer surgery with a degree of precision not currently possible through existing surgical procedures. About the size of a ring box, nanorobots could revolutionize surgical practice within the next five to 10 years by making procedures of all sorts more precise and safer, claims Jalili.

"Precision," he said, "is one of the most important aspects of a surgical procedure." Guided by image-based information, the futuristic mechanical device would rely on a number of motors that move in tiny, exact increments, enabling it to pinpoint the exact

location of a tumour or other surgical object. "While a surgeon's instruments cannot get to within a millimetre of a tumour, we will be able to precisely guide the robot to a location at a sub-nanometre or nanometre resolution, enabling us to see things that we could never see before," Jalili said. A nanometre is .000001 millimetres, and a nanotube is 1/1,000th of the thickness of a human hair. His nanorobots could also be used to take minute skin samples for pathological testing as well as for diagnostic purposes, or to inject medicine or other fluids very precisely into a patient's body in order to destroy a tumour. Effective nanorobots would not put surgeons out of work, said Jalili. On the contrary, they would take on supervisory roles in the operating room. Surgeons would follow the procedure and supervise, should anything go wrong. This is not science fiction, it is real. The National Cancer Institute and NASA plan to spend \$12 million a year over the next three years to develop nanosensors, devices with less than one-thousandth the diameter of a human hair that will scan the body for the molecular signatures of cancer, the aberrant proteins found on malignant cells, for instance, and map the locations and shapes of tumours. If engineered to carry drugs or genes, the sensors could treat cancers one cell at a time, attacking malignant cells but leaving healthy ones unharmed. The result: an end to the pharmaceutical carpet bombing that we call chemotherapy, not to mention its attendant miseries [25].

In 1910, in an address delivered on October 3rd by William Thorburn at the opening of the medical session of Manchester University, it was said: "..... In 1876 Lawson Tait first removed some stones from the gall bladder and the daring operation was regarded as one which might occasionally be adopted: in 1909, Mayo Robson had collected 3,000 such operations performed by three surgeons alone, and with a mortality of less than 2 per cent. Some 20 years ago, the operation of gastroenterostomy was introduced to surgery: it is now one of the commonest remedial measures to rescue many thousands from the slow martyrdom of so-called dyspepsia. In 1896, an Italian surgeon, Farina, made the first attempt to suture a wound of the heart itself and in 1909, Vaughan collects 150 cases with 35 per cent, saved from certain death.....". He described the evolution of surgery [26].

Nowadays, a hundred years after the address of William Thorburn, we describe and perform surgical procedures which 100 years ago were just fiction or impossible for anyone to foresee.

It is difficult to predict the "changing face of surgery" for 2110, but I can predict with certainty

that the face of surgery will undergo such dramatic changes that will alter the entire concept of surgery as it stands today.

As already established, no alteration in surgery lasts for ever. It is very important to be aware of its clear indications, to know when to accept or reject it, and to be alert to new developments. What we considered as mere fantasy till yesterday could well be the reality of tomorrow.

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