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Development of surgery during the last 50 years

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Modern Surgery: More than 100 years old

Modern surgery goes back to the last part of the 19th century. At that time one began to manage the three big enemies of surgery, namely bleeding, pain and infection. Surgery was particularly revolutionised by the introduction of anaesthesia and the understanding of antisepsis and asepsis. Ether was used for the first time in 1846, more exactly the sixteenth of October, which is considered the birthday of anaesthesia. On this occasion the Boston surgeon John Warren removed a neck tumour in a young man under ether anaesthesia and in the presence of an assembled audience expressed the famous words: "Gentlemen, this is no humbug".

The father of antisepsis is the British surgeon, Joseph Lister. Inspired by Louis Pasteurs' papers on fermentation he could show that application of carbolic acid (phenol) to wounds had a remarkable disinfectant efficacy and lowered the mortality in the treatment of compound fractures. His antiseptic system was published in The Lancet in 1867.

Anaesthesia and asepsis constituted the grounds for the "first" development of surgery that took place during the last decades of the 19th century; that was especially true for abdominal surgery. The stomach operations such as Billroth I and II procedures were established as well as biliary surgery. Also gynaecological operations became more common. The progress of abdominal surgery lasted until the 1920s.

During the first half of the 20th century an increased specialisation of surgery took place. Thoracic surgery was introduced and operations against lung tuberculosis and lung carcinoma predominated. In thoracic surgery Ernst Ferdinand Sauerbruch became a pioneer. Neurosurgery developed, especially led by Harvey Cushing, and in our country Herbert Olivecrona became the great name. Vascular surgery made progress and the suture technique was introduced by Alexis Carrel. For that he received the Nobel Prize in 1912. Orthopedic surgery improved and the first cup arthroplasty of the hip joint was carried out in 1939 by Marius Smith-Petersen. During the 1940–50ies there was a continuous improvement of surgical technique and

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wound treatment, but the great advances belong to the period after the Second World War.

Most important advances have been made during the second half of the 20th century

A prerequisite for the surgical progress was the advances in anaesthesia during the last four to five decades. The modern anaesthetics in combination with muscle relaxing agents have facilitated surgery. Of available methods afferent neural blockade by epidural anaesthesia has been most important for reducing the stress response of surgery. Early mobilisation in association with adequate pain relief has contributed to decrease the risk for postoperative complications. A better understanding of the need of fluids and nutrients in the postoperative period and how to manage failing organ functions have also improved the surgical outcome during recent decades. Oral nutrition is preferable but parenteral administration is often necessary and the modern use of proteins, fats and carbohydrates in combination with minerals and vitamins can keep a patient in an adequate nutritional condition for an unlimited period.

Milestones in transplantation

Transplantation is one of the most important advances in medicine in the 20th century. From the beginning transplantation was focused on the kidney. In the 1960s hemodialysis was thought to be the most acceptable treatment for individuals with chronic renal failure. In 1945 the Dutch-American surgeon Willem Kolff had used such a machine for the first time. The following year the Swedish physician Nils Alwall introduced his so-called artificial kidney, first used in a 49-year old man with silicosis. The dialysis was successful but the patient died the day after from pneumonia. Treatment with hemodialysis developed gradually but several clinicians claimed that transplantation should be more realistic in individuals with chronic renal failure. A major reason for initiation of the transplantation concept was that clinicians were faced with persons dying of terminal renal disease, whose only barrier to health was that their kidneys were diseased. Another reason for an initiation of a kidney transplant program was to get “control” of hypertension.

In spite of the fact that tissue matching, immunosuppression and organ preservation was still unknown, energetic surgeons started kidney transplantation in the 1950s and the efforts made by surgical teams in Paris and Boston became widely known. The surgical problems could be technically controlled but the kidneys functioned only for a short time and the human recipients often died after a few days. The only unequivocal example of clinically significant allograft function through 1954 was provided by a Boston case, whose kidney produced life-supporting urine for almost six months.

Subsequent research concentrated on solving the rejection problems, i.e. to face the immunological questions. Hitherto transplantation had left little room for optimism. The only transplantation that theoretically could become successful was

organ grafting between twins – individuals with genetic identities. Therefore, the hopelessness was changed when Joseph Murray at the Peter Bent Brigham Hospital in Boston two days before Christmas in 1954 carried out the first "twin-transplantation". A uremic 23-year old man received a kidney from his identical twin brother. The kidney was grafted to the pelvic location, and it functioned promptly despite 82 minutes of warm ischemia. For the first time organ transplantation had cured a patient and it was obvious that technical problems had been overcome. The recipient lived for almost 25 years before he died of atherosclerotic coronary artery disease.

During the following years the British biologist Peter Medawar contributed to the development of our knowledge of basic immunology of organ transplantation. Medawar's observations led to Murray in 1961 performing the first successful transplantation with a cadaveric kidney from an unrelated donor. Both Medawar and Murray were awarded the Nobel Prize in Medicine, receiving their prizes in 1960 and 1990, respectively. Murray shared the prize with Donnall Thomas for his work on bone marrow transplantation.

The first transplantation in Sweden

In our country the first organ grafting was performed by Curt Franksson in 1964, when he carried out a kidney transplantation. The recipient was a 17-year old boy and his father was the donor. At the operation the "lymph drainage technique" was used to reduce the lymphocytic attack on the allograft. The pioneer work by Franksson opened the interest for transplantation activity in more places in our country. In Gothenburg a renal transplantation program started the year after and in a ten-year period no fewer than 500 transplantations were performed there. In Uppsala the transplantation program started in 1967 when Lars Thorén performed a renal graft. Today the annual number of renal transplantations in our country is 250–350.

Liver-, heart- and pancreas transplantation

Improved clinical immunosuppression and organ preservation increased the interest among surgeons for transplantation of other organs than the kidney. During the 1960s particularly, liver, heart and pancreas transplantation came in focus. Thomas Starzl in Denver performed in 1963 the first liver transplantation. Within the succeeding four years 13 more liver transplantations were carried out, eight of them in Denver. The early results were rather discouraging; the longest survival was 34 days. The first liver transplantation in our country was performed in Stockholm in 1984 by Carl-Gustav Groth. A 16-year old girl with a hepatoblastoma was successfully given a "new" liver but she died 18 months later due to recurrence of her liver tumour.

The first heart transplantation in the world was undertaken in Cape Town in 1967 by Christian Barnard following an extended visit by the South African to American transplant centres. The heart was taken from a traffic casualty but the recipient died from infection after 18 days. The second patient in his series lived several years. The year after Barnard's operation American surgeons started heart transplantation

and in 1980s this type of surgery became more frequent. In Sweden heart transplantation was carried out for the first time in 1984 by William-Olsson, Gothenburg. In our country the activity was hampered by the fact that the concept of brain death was accepted first in 1988. Today about 55,000 individuals have worldwide undergone heart transplantation; in our country almost 400.

In 1967, also, the first pancreatic transplantation was undertaken in Minneapolis. In Sweden the first pancreatic grafting was performed ten years later by Groth, who became one of the international leaders in the field of pancreas transplantation and xenotransplantation. Concerning pancreas it is still an open question as to what extent a grafting of the whole organ can be replaced by transplantation of only the insulin-producing cells. The ongoing activity seems, however, promising.

Survival after organ transplantation has improved

The results of organ transplantation have gradually improved, particularly after the introduction of cyclosporin in the 1980s. In renal transplantation the 5-year survival is about 85 %. In liver grafting the outcome is related to the indications; in chronic diseases the 5-year survival is around 80 %, in hepatic carcinoma only 20–30 %. In heart transplantation about 75 % are alive after 5 years but when the heart is transplanted with both lungs the survival rate is lower (around 40 %). The results of pancreatic transplantation are also satisfactory; around 75 % are alive after 3 years. The success of islet cell transplantation is still being determined.

Open heart surgery

The development of open heart surgery was another milestone in the period after World War II. This kind of surgery was first carried out without extracorporeal circulation, i.e. without using the heart-lung machine. The operations were undertaken during hypothermia and circulatory arrest. The anaesthetised patient was cooled to 26 to 30 degrees C body temperature and alcohol was administered intravenously to reduce the risk for ventricular fibrillation. In 1953 Thomas Lewis performed the first clinical case with this technique. While he was in Minneapolis he closed an atrial septal defect. After this breakthrough many clinics started open heart surgery during hypothermia. The operations were usually limited to corrections of different heart malformations. It became, however, apparent that the hypothermic technique was insufficient for more complicated cases and there was a need for a heart-lung machine that could give total circulatory support. The one who more than others realised the problems was the American surgeon John Gibbon. He came more or less to devote his life to construction of a heart-lung machine. Many questions had to be solved and after a series of experimental studies on animals Gibbon was ready in 1951 to use his machine. The first operation failed, as did the second in 1952. However, the third operation in May 1954 became successful when he closed an atrial septal defect in an 18-year old woman. During 26 minutes the patient was completely dependent on the heart-lung machine. The operation made a great impact and Gibbon was appropiately honoured for his contribution.

Swedish surgeons have played an important role in the development of heart surgery. Names such as Clarence Crafoord, Viking Olof Björk and Åke Senning have to be mentioned. They constructed their own heart-lung machine and there ensued almost a competition which team – the Gibbon- or Crafoord-team – whould be the first with a successful open heart operation during extracorporeal circulation. The Swedish surgeons performed their first clinical case only 2 months after Gibbon's successful operation. On July 14, 1954 the Swedish team removed an atrial myxoma in a 42-year-old woman. During the operation the patient was cooled to 28 degrees C and the total bypass lasted for 26 minutes. The postoperative course was uncomplicated and the patient showed no clinical signs of cardiac or cerebral damage. After several years of experimental work the Swedish surgeons had proved that their machine was of clinical value.

Historically it is of interest to mention that the aviator Charles Lindbergh became involved in construction of a heart-lung machine. The reason was that he had a close relative with a heart failure needing an operation with extracorporeal circulation. Lindbergh got information from Alexis Carrel and he constructed a machine with good pump-function. However, Carrel had forgotten to inform Lindbergh that the blood also had to be oxygenated. When he became aware of this he gave up the project.

In the 1950s surgery against angina pectoris became of interest. Several methods were used. One of them was the pericardio-myocardiopexy advocated by Beck. Another was Vineberg's technique of implanting the mammary artery in the myocardium in an attempt to achieve anastomoses with the coronary arteries. In the 1960s the coronary bypass-operation was introduced and this kind of operation is now a routine procedure. Today the PTCA-method introduced by Andreas Gruntzig in 1977 has become common.

The first implanted pacemaker

For more than 200 years it has been well known that the heart can be stimulated to contract by electric current. In the early 1950s atrio-ventricular blocks were treated by external pacemakers with the electrodes applied on the chest. It was a great advance when Åke Senning in collaboration with another Swedish doctor, Rune Edling, implanted the first pacemaker. The patient, an electrical engineer, had been hospitalised for about half a year for Adams-Stokes attacks. The pacemaker worked only for 8 hours, whereupon it had to be replaced by a new one that functioned several months. The patient lived until he was 86 years old and during his life he got no fewer than 27 pacemakers. Today the technique has improved and the batteries have a long duration.

Endoscopic surgery

In the 1950s the first fiberoptic instruments were introduced and by these our diagnostic procedures became improved and also facilitated. First the fiberoptic technique was used for gastroscopy. Equipment for gastroscopic investigations was

already used in the late part of the 1900th century but first after the fiberoptic instrument was constructed this kind of endoscopic investigation became common.

Scopes for investigations of the bile and pancreatic ducts (ERCP) have been added as well as instruments for colonic examinations. The advantages of the endoscopic investigations have resulted in conventional roentgenologic examinations of the gastrointestinal tract being relatively infrequent nowadays.

Endoscopic surgery has become one of the biggest success stories in the history of medicine after World War II. However, laparoscopy is not new. Already in 1910 the Swedish doctor Hans Christian Jacobeus in Stockholm reported the first clinical laparoscopies and thoracoscopies. The main purpose of his work was to diagnose and treat tuberculosis.

Modern endoscopic surgery started during the 1960s when gynaecologists began interventions on more regular basis. Somewhat later some surgeons took up the laparoscopic technique but only for diagnostic purposes, particularly for diagnosis of liver diseases. However, the "key-hole" surgery was regarded with scepticism. The real breakthrough came in 1985 when the German Erich Muhe performed the first laparoscopic cholecystectomy. The technique then evolved very quickly and today endoscopic surgery is incorporated into surgery generally and used in several fields. Today most cholecystectomies are performed laparoscopically and during the last decade there has been an increasing interest in laparoscopic appendectomies. Another operation suitable for laparoscopic operation is the Nissen fundoplication. The advantages with laparoscopic surgery are the "minimal invasiveness", less postoperative pain, quicker recovery and better cosmetic results. The disadvantages are longer operating time and possibly more complications. A formalised education program for surgeons in laparoscopic procedures seems important before they can be permitted to utilise the technique independently.

Antibiotics

The progress of bacteriology has been of essential importance for the development of surgery. The antibacterial property of Penicillium notatum was described by the Scottish bacteriologist Alexander Flemming already in 1929 but it was not until 1941 before penicillin was clinically used for the first time. After the introduction of penicillin there has been continuous progress and during the last decades a broad spectrum of antibiotics has developed. Today there is a wide variety of effective drugs to combat infections and septic conditions associated with surgery.

Furthermore, preoperative administration of antibiotics to prevent postoperative infections represents another cornerstone of modern surgery. The general principles of surgical prophylaxis are today quite clearly defined in most departments and have, no doubt, reduced the risk for severe infections in the postoperative course. However, advances in surgical techniques, changes in bacterial ecology in hospitals and the risk of bacterial resistance have to be considered during the coming years. It seems important that adequate guidelines for surgical prophylaxis will continuously be worked out.

Need for subspecialisation

In our country general surgery has gradually undergone a subspecialisation since the 1970s. In our university hospital and in most of our tertiary care hospitals there is now specialisation into gastrointestinal surgery, vascular surgery and endocrine surgery. The surgeon has become more a part of a team and the successful development of surgery has been possible due to close co-operation with other disciplines.

Future aspects

Surgery has always been dependent on technical progress. Increased knowledge in ultrasound and video engineering as well as the introduction of new instruments and implants have contributed to the development of the "minimally invasive surgery". In the future it is likely that surgery will be more technology driven. The operating room requires much more of technical components to meet different requirements of the surgical disciplines. In different fields surgery has become more "conservative" and functional, e.g. breast saving operations for breast carcinoma and sphincter saving in cases with rectal carcinomas. Endovascular procedures will be more common and stenting will be a useful treatment not only in vascular cases but also in cases where it is important to hold open various ducts. In the last few years there has been great interest for using interstitial procedures, such as laser coagulation or radio-frequency ablation particularly in therapy of liver metastases. In spite of this the need for major radical surgery will probably remain and it is likely that major surgery will become more regionally centralised.

References are available on request.

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