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Review article

Historical Journey of surgery and surgeons

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ABSTRACT

Surgery as a science and a craft has passed through a very long and exhausting journey, during which its significance, influence, proportionate contribution to public health, its regard in society and overall landscape have changed dramatically. From a secondary, poorly founded and modestly appreciated profession, to a highly esteemed practice and academic discipline whose members command the highest levels of respect and attention among fellow academics, medical practitioners and the public. Parallel to those changes, the surgeon's status, character and qualifications have changed drastically through the ages too. With the thrive of surgery and surgeons, their code of conduct and ethics have developed as well. In this subject, we discuss the journey that the surgical profession had endured, from the earliest pre-historic ages, through the first civilizations of the ancient world and the middle ages, up to its re-formulation into the modern form we know nowadays. With that journey, we discuss how surgeon's social and scientific status in the community have changed, how the process of specialization developed, as well as the main points of weaknesses that have repeatedly hindered the advance of surgery.

Background

surgery, branch of medicine that is concerned with the treatment of injuries, diseases, and other disorders by manual and instrumental means. It is as old as humanity, for anyone who has ever stanchied a wound has acted as a surgeon [1]

Surgery, despite being a well-established core practice of the medical profession and healthcare, still seems counter-intuitive by human instincts. The idea of using instruments and knives to cut, alter, penetrate and manipulate living humans' tissue is gory and repulsive to many lay people. Yet it has always been a life-saving necessity throughout human history. Knowing about how this discipline first emerged, and how it evolved to reach its current status, as well as the

implication of these developments on medical practice itself, and on surgeons and their place in society is a valuable education.

Surgical practices in some shape or form have existed throughout history. Evidence that dates back to the stone age shows (trephining) operations, where holes were cut in skulls with tools. The purpose of those operations is not certain, but it's suggested to be likely to relieve pressure off the brain. Evidence also shows - through signs of healing - that many of the patients survived those operations. [2,3]

Evidence of more advanced practices comes from ancient Egypt. The Egyptians had good understanding of human anatomy through the

practice of mummification. They treated wounds, broken bones, boils and abscesses. They used sutures, clamps and cauterization. They had instruments like probes, saws, forceps, scalpels and scissors. They gave us one of the oldest engravings of a surgical procedure: circumcision. They also gave us the oldest written works of surgery: The “Edwin Smith Papyrus” dating back to 1600 BC, which is a manual for traumatic surgery, describing management of a broken nose, dislocated vertebra and performing sutures to close wounds. They also gave us the longer, more complete “Eber’s Papyrus”, dating back to 1550 BC, describing treatment for crocodile bites, burns and drainage of abscesses. [4,5]

The Indians were pioneers of plastic surgery. There were hospitals in India and Sri Lanka dating back to before 200 BC. They devised and performed operations to reconstruct the nose (rhinoplasty). The most prominent figure is Sushruta (between 1200 and 600 BC), who is considered “the founding father of surgery”. He wrote a series of volumes which are one of the earliest known surgical texts. Describing in great accuracy and detail the examination, diagnosis, treatment and prognoses of numerous ailments, as well as procedures of cosmetic, plastic surgery and rhinoplasty. [4,6]

Hippocrates, who is considered the father of modern medicine, gave a collection of works that discussed many surgical topics, injuries, treatments and instruments, such as wounds, ulcers, hemorrhoids and fractures. The Alexandrian scholar Herophilus (c. 335-280 BC) carried out dissections of human bodies in public. He is sometimes called the father of anatomy. Alexandrian scholars carried out many developments in ligature (hemostasis), lithotomy, hernia operations, ophthalmic surgery, plastic surgery, methods of reduction of dislocations and fractures, tracheotomy, and using mandrake as anesthesia. [3,7]

The practice of medicine in the following era under the Roman was still mainly dependant on the Greek practitioners. However, two prominent Roman names emerge with significant contributions in the field of surgery: Celsus and Galen. Galen’s views dominated the practice of medicine in Europe for almost 15 centuries, while the work of Celsus, who was hardly influential during his own time, became highly valued during the Renaissance. [3,7]

Arabic Scholars and the renaissance

Hunayn ibn Ishaq (873–809) (حنين ابن اسحق) kickstarted the contributions of Arabic civilization to medicine by translating many Greek medical and scientific texts to Arabic [8]. Abū Bakr Muhammad ibn Zakariya al-Razi (أبو بكر محمد ابن زكريا الرازي 925–854)), advanced experimental medicine, pioneering ophthalmology and founding paediatrics [9,10]. He is famous for the story when he wanted to choose the ideal site for building a hospital, so he distributed pieces of raw meat across town. He had deduced that the site where the meat lasted the longest without rotting (putrefaction), would be the best site for the hospital. This is one of the earliest examples in history of the scientific method and experimental medicine [11].

Abū al-Qāsim Khalaf ibn al-‘Abbās al-Zahrāwī (1013–936) (أبو القاسم خلف ابن العباس الزهراوي) was an Andalusian physician, surgeon and chemist. He is considered the greatest surgeon of the Middle Ages, and also described as the father of surgery [12-14]. His principal work is “Kitab al-Tasrif كتاب التصريف”, a thirty-volume encyclopaedia of medical practices. The surgery chapter of this work was later translated into Latin and became the standard text book in Europe for the next 500 years. Al-Zahrawi stated that he chose to discuss surgery in the last volume because surgery is the highest form of medicine, and one must not practice it until he becomes well-acquainted with all other branches of medicine [15,16]. He introduced over 200 surgical instruments (scalpels, retractors, curettes, pincers, specula, hooks, and also instruments designed for his favoured techniques of cauterization and ligature. Many of these instruments were never used before [17]. He performed surgical treatments of head injuries, skull fractures, spinal injuries, hydrocephalus, subdural effusions and headache [18]. He gave early descriptions of some medical procedures that were ascribed to later physicians e.g., Kocher’s method and Walcher’s Position [19]. He described tools and performed procedures for inspecting the urinary tract, extracting and crushing urinary stones [20]. He was also credited to be the first to perform teeth re-implantation in the history of dentistry [21].

Many other influential scholars include: Ibn Sīnā (ابن سينا 1037 – 980) and Ibn Rushd (ابن رشد 1198– 1126) [22]

Modern surgery.

In this review of modern-day surgery, I choose not to focus on the solid dates and figures, or the sequence of historical events, but rather on how the state of surgical profession has evolved through time, and the associated changes in surgeons' beliefs, attitude, life style, social status and ethical views.

Surgery as we know did not truly begin until the late 1700s with the "age of enlightenment" in Europe, centralized in Great Britain. Back then, the risk of Mortality after major operations was over 50%. Exploring the abdomen was almost always fatal [23], the chest and joint were not accessible. Surgeons mostly dealt with "external wounds", while medicine dealt with internal problems, hence the term "Internal Medicine" [24]. Even in externally accessible conditions e.g., spina bifida, accounts often spoke of failure more than accomplishment [25]. The two greatest limitations to surgery were pain (from the procedure) and infection [24].

Furthermore, attempts of surgical intervention were often driven by illusion and unfounded hypotheses e.g., Mr Preston reported treating a man with acute stroke by ligating the patient's right common carotid artery! He believed that by diminishing the supply of blood to the affected side of the brain, the treatment would reduce congestion and inflammation. Surprisingly, the patient survived, and after recovery he was walking with the aid of a stick and speaking normally. So, Preston proposed that surgeons should consider tying both carotids in future cases [26]!

A great deal of credit in rewriting surgical approaches and its related beliefs goes to "John Hunter" (1728-1793). Regarded as the father of modern "scientific" surgery, "John Hunter" introduced experimental approach to surgical practice, refusing to rely on existing practices, old beliefs and subjective testimonies. He conducted his own experiments and comparative analysis to determine the truth from myth, thereby reconstructing surgical knowledge from zero level, and reshaping the landscape of surgical practice [27].

The moment that changed not just the future of surgery but of medicine as a whole, was the publication of Henry Jacob Bigelow's groundbreaking report, "Insensibility during Surgical Operations Produced by Inhalation" in 1846 [28]. A dentist "William Morton" administered to his own

patients, and then to several more who had undergone surgery, a gas he called "Letheon", which successfully rendered them insensible to pain [24].

To put in perspective how different surgery was before, and how it was radically changed after the advent of anaesthesia, consider the procedure of leg amputation: a procedure had long been recognized as lifesaving, and at the same time horrific. Patients had to be pinned down during operation, and surgeons used techniques favouring speed over precision. Amputations usually took less than a minute [24, 29]! The sounds of patients thrashing and screaming filled operating rooms.

However, 2 months after Bigelow's report, the famous Robert Liston performed his first amputation under anaesthesia on a 36 years old patient with septic knee [30]. The patient didn't move or make a sound throughout the procedure, and after he woke up, he thought the procedure hadn't started yet.

The operation took only 25 seconds from incision to wound closure! Liston, like most other surgeons at the time, proceeded in that operation with his usual lightning-quick and bloody way [30]. It took a little while for surgeons to discover that the use of anaesthesia allowed them time to be meticulous. Liston was famous for operating so fast that he once accidentally amputated an assistant's fingers along with a patient's leg! The patient and the assistant both died of sepsis, and a spectator reportedly died of shock, resulting in the only known procedure with a 300% mortality [24].

However, anaesthesia allowed surgeons to perform more complex, invasive, and precise manoeuvres than they had dared to attempt before.

The third big leap came after, with the revelation of the deadly effect of infection on the outcome of surgeries. The mortality associated with major abdominal or limb operations commonly remained at 50% or higher owing to infection. In 1847, Ignaz Semmelweis, an obstetrician, while working at the Viennese hospital, was puzzled by a strange phenomenon: The hospital had two maternity clinics, but one of them had a much higher rate of mortality rate due to puerperal sepsis than the other (10% and 4%). So, he began a meticulous process of eliminating all possible factors that could explain that difference in mortality. He even considered trivial factors like difference in climate or religious beliefs between the two clinics. But for a long time, his search didn't provide any reasonable

explanation. Both clinics followed the same techniques. He was even more puzzled to find that mortality rate among women who gave birth in the streets is lower than the 10% rate of the first clinic!

After almost a year, his breakthrough came with the death of a dear friend of him, who had accidentally been stabbed by a medical student's scalpel. He found that his friend's wound showed the same pathology as that he found in cases of puerperal sepsis. He found the only real difference between the two clinics, as the first clinic was used to teach medical students, while the second was used to teach midwives. Medical students would engage in autopsies and dissection of deceased patients, and then proceed to perform deliveries, while midwives did not engage in autopsies or contact with corpses. He concluded that medical students are carrying the "deadly agent" with their hands and instruments from corpses to mothers! So, he instituted a policy of mandatory hand wash before examining patients, which led to immediate and remarkable drop in mortality rates [31,32].

In 1867, Joseph Lister published a series of articles describing the effectiveness of a new system of antiseptics using carbolic acid. He based his research on the work of the famous "Louis Pasteur" on rotting, fermentation and micro-organisms [33].

Until that time, surgery's contribution to medical science was poor. Only about one fifth of published scientific articles were surgical. However, since the established use of anaesthesia and disinfectants, from the mid-19th to 20th century, surgical advances took up half the volume of articles. New surgical treatments were reported almost monthly, and surgery became a dominant force in medical advancement [24].

A series of "firsts" rapidly followed, each more daring than the last: The first appendectomy [34], the first subtotal thyroidectomy [35], the first Total hysterectomy with bilateral Oophorectomy, the first successful removal of a brain tumor [36], suprapubic prostatectomy, total gastrectomy, chest surgery, joint repair [37,38]. suturing blood vessels and surgical grafts. Surgeons developed such skill and confidence that they began performing exploratory laparotomies just for the purpose of diagnosis!

The Surgeon's title

But it might be surprising to know that traditionally – and until today – surgeons from the United Kingdom and affiliated nations like the

Republic of Ireland, are addressed by the title of (Mr.) and not (Dr.)! The cause of this strange custom is even more surprising, as surgeons originally were not doctors! And modern surgery does not descend from the same lineage as modern medicine! In the beginning of the 18th century, physicians were gentlemen who received university education and possessed a "medical doctorate" (MD) which entitled them as "doctors". Surgeons however, rarely had any formal education or degree! Instead they usually served as an apprentice to a surgeon. They were just "manual craftsmen" working only under the supervision of the "superior" physicians [39,40]!

This changed rapidly over the next century with the rapid growth of the number of voluntary hospitals, combined with the stagnation of the medical profession because of the difficult rules and restraints on admission to medical universities. The number of surgeons grew rapidly within these hospitals. The brilliant work of individuals like "John Hunter" rapidly advanced the status of surgery and surgeons, turning surgery from a trade into science [39]. "Hunter made us gentlemen", Sir James Paget [41].

The Royal College of Surgeons of London was founded in 1800, and it became customary for surgeons to take the examination for Membership of the Royal College of Surgeons and put "MRCS" after their name [42].

John Abernethy (1764-1837) highlights this change with his quote:

"There was a time when surgeons were considered as mere appendages of physicians, the mere operators to be put in motion by their directors: but times have changed and surgeons are changed too . . . and in consequence have got a kind of information which puts them on a par with others of the profession"

«كان هناك زمن لم يكن الجراحين يعدون أكثر من زوائد (مساعدين) للأطباء، العمال اليدويين الذين يتحركون بأمر رؤسائهم: ولكن الزمن تغير والجراحون تغيروا أيضا . . . وبذلك صار لديهم العلم الذي يضعهم على قدم المساواة مع نظرائهم.» [43]

By the early years of the 19th century, surgeons at the London teaching hospitals were earning the highest medical incomes and saw themselves as being at the very top of the medical tree. Being addressed as Mr was no longer a put-down and became a badge of honour and distinction.

Surgeons in 1730 were not entitled as Dr, but hospital surgeons in 1830 had no wish to [39].

Surgical specialization (From a side-specialty to subspecialty)

Since the USA was the prominent driving force in the fields of science – including medicine and surgery – during the past century, so it was for the drive towards medical and surgical specialization, and so we will discuss how that development was brought about in the USA.

The dominant form of physicians up to the late 19th century was the “general practice” doctor, who practices surgery as a side-specialty [44]. By the 1880s, doctors began to realize that by devoting themselves to one branch instead of working up a general practice, they could often do more good, earn more money, and have less arduous work. However, opportunities of “specialty training” were poor, in the form of “private” courses by “specialists”, or short courses at medical schools [45]. Many travelled seeking specialty training in Europe [46].

William Stewart Halsted (1852–1922), who is considered the “Adam” of surgery in America, established the resident system of training surgeons at the Johns Hopkins Hospital in 1889. That was the first surgical residency training program in America, spanning a minimal of 8 years of training. But despite later significance of this program in the rise of surgery as a specialty in America, its early years impact was quite modest, mostly due to the fact that throughout Halsted’s entire life of training, only 17 students survived his gruelling method of surgical training [44,47]!

John Allan Wyeth (1845–1922) highlighted the defect in specialty training: “Not once in my two years of study, did I enter the wards of a hospital or receive instruction by the bedside of a patient” [48].

he suggested that a new style 4-year medical school should be organized in which the final years were devoted to clinical work, and began advocating his idea but failed to raise finances. So, he organized a simpler “postgraduate medical school,” to replace the “fourth year course” of the institution he proposed [48,49]. He opened “The New York Polyclinic” in 1882 in the bottom floor of a decayed building. His marketing strategy was to emphasize on practical and clinical “Hand’s on” training policy instead of theoretical lectures, and

appeal to rural practitioners who are denied the chance to work at more advanced urban centers [44].

In parallel to the opening of the Polyclinic, a group of distinguished Manhattan physicians opened the “New York Post-Graduate Medical school”, which had similar philosophy and marketing strategy, and it opened at the basement of the college of pharmacy. Both schools achieved instant success. 18 individuals were enrolled in the course of the Polyclinic, while a dozen or so were enrolled in the Post-Graduate. By their 10th anniversary, they enrolled about 1000 pupils annually and had about 3000 graduate each [50]. The competition between both schools gave more drive for excellence, and they attracted star physicians and prominent university staff to work as instructors [44].

Soon after, both schools published their own medical journals to assert their scientific weight and advertise their work [51]. Both abandoned their old single-floor location to build fully-equipped multiple-story hospitals, which dominated the medical practice in New York [44]. Similar schools opened throughout the country [52]. Both schools had thousands of graduates trained in specialty practice, and soon after became the foremost figures in general surgery and specialties like orthopaedics, ophthalmology, Gynaecology, ENT. Medical schools started building their own teaching hospitals [44]. In 1913, more than a thousand men gathered to announce themselves as specialists in surgery and the formation of the American college of surgeons [44,53].

Surgeons’ sins: the bumps in the path to advancement

•Pride and prejudice

The unspoken truth about the history of medicine in general, and surgery in particular, is that the biggest barrier in the path of surgical advances was surgeons themselves! The main bulk of the surgical society often met new discoveries and innovative techniques with scepticism, sarcasm and a surprising degree of stubbornness, and refusal to change traditional methods and old concepts. This comes more surprising when demonstrated by a class of men considered as (men of science).

When “Morten” first displayed the benefit of his anesthetic gas, he was met with suspicion and repression. Many described his invention as “needless luxury 24] ” [رفاهية لا داعي لها] “Liston” himself publicly expressed doubt in it’s value before

he performed his first amputation under anesthesia [30].

“Lister’s” report of carbolic acid as antiseptic was also met with overwhelming scepticism. First articles discussing this method claimed it as neither original nor beneficial [54]! And that continued up to a decade later [55]. And more than three decades after “Ignaz Semmelweiss” explained the value of hand washing before delivery, operators would still proceed to operation wearing clothes that carry the stains of blood and secretions from the previous operation [56]!

Despite the fact that the first laparoscopic operation was performed on a human in 1910, advances remained quite slow in that field for nearly 70 years, partly due to technological limitations, but also due to repression by the old guards of traditional surgery [57].

•Greed and Selfishness

Pride was not the only sin that slowed advancement, but the other galling sin was self-interest. “Morton” himself tried to keep the composition of his anesthetic gas a secret so he alone could benefit from it [24]! But no example better demonstrates the horrible infliction of selfishness on the medical profession and public health than the story of the “Chamberlin family”. “The Chamberlin family” were famous obstetricians throughout the 17th and 18th century. At that time one of every 10 births resulted in fetal death, due to crushing the head by the obstetrician during delivery. Even normal delivery was a grand risk for both the mother and fetus [58].

“The Chamberlin family” were famous for having a much higher delivery success rate than anyone else, and for 150 years no one understood why. It was later revealed that a member of the family had invented the “Obstetric forceps” which made pulling the baby’s head during delivery safe and easy. But they decided to keep that tool a secret, never allowed to be seen, and even delivered to the operation room in a sealed box. Even the patient was blindfolded [58]!

It's horrifying to Imagine the number of babies that died unnecessarily for the period of 150 years due to the soulless greed of a single family. Or the number of those who died from sepsis even after dis-infection was devised, just because it wasn't properly acknowledged. Surgeons who risk the lives or health of patients because they refuse to acknowledge a new technique, or those who have

knowledge, skill or experience but refuse to share it with colleagues and students, are responsible for the death or injury of those patients, and so they are invariably murderers.

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