Surgical Workshop: Early Nineteenth Century Surgery

MKH CRUMPLIN

The audience for the 19th century surgical workshop was a mixed group of retired and active clinicians – also many medical students and junior staff, the former being mostly members of the ‘Surgical Scousers’. During the workshop demonstrations, I was ably assisted by my wife, a retired hospital gynaecologist. The aim of the workshop was to familiarise the group with surgical training and practice 200 years ago, before the advent of antiseptic surgery (1865) and anaesthesia (1846). Another objective of the session was to impress the group that there are many myths and misunderstandings regarding practice at these times, it being fundamental to get into the mindset of the surgeons, the limited achievements of surgery and expectations of patients with their outcomes. The workshop was based around a power point display of images and a collection of artefacts and medical instruments – also a display and explanation of some of the more frequent operations in surgery performed at that time.

Firstly the derivation of the word surgery was explained. It is derived from a combination of two Greek words, ‘Kheir’ (meaning hand) and ‘Ourgos’ (work). The Latin word is ‘Chir-urgia’. An old English word for surgery is ‘Cyrurgerye’. In defining both ancient and modern surgery, there is an inherent need to assess which type of patient with his/her wound or disease needs to undergo what type of operation. Timing of surgery was and still is critical. Manual dexterity is required to undertake procedures and the type of surgery performed 200 years ago was crude, rapid and stressful, not only to the patient, but often to the surgeon as well! Postoperatively, complications were all too often seen, which had to be promptly and skilfully managed and the patients followed up if death was to be averted. Senior metropolitan surgeons, usually giving their hospital services gratis, also had to train and teach pupils, ‘plaister men’, dressers and house surgeons. They also had to record their work and often administer a practice or hospital ward. In these pre-anaesthetic and pre-antiseptic days, a safe passage was not guaranteed. A decent surgeon could choose his patient well, operate swiftly and control bleeding, but pain was not controlled and sepsis, deformity and a lingering death must have been considerable disappointments to the conscientious surgeon.

* Address for correspondence: mickcrumplin@doctors.org.uk
The training of a young surgeon was ill-structured except in the best hands or institutions and lasted around seven years. A parish, church or private school was attended (some wealthy children were tutored privately) until around 14/15 years of age. The potential surgeon was then joined as an apprentice to a city or provincial surgeon or surgeon-apothecary. This arrangement took the form of an indentured apprenticeship and a formal document had to be signed by parents and master.

This agreement cost (usually the family of the candidate) between £50 and £300 – depending on the master’s status and whether the apprentice paid his master to stay at the latter’s house. By and large, the costs were lower north of the border. At about twenty years of age, the apprentice would terminate his course and enter some type of hospital to walk the wards, watch surgery, attend dissections and attend winter and autumn courses of lectures on anatomy, surgery, material medica, etc. These would cost around 3-5 guineas a series.

Figure 1: Advertisement for Sir Charles Bell’s Lectures, 1814 (Author’s collection).
Between 1725 and 1815 there was a significant increase in pupils entering London teaching hospitals; around 25 per annum in 1725 increasing to around 300 in 1815.

Besides lectures, attendance at dissections and surgery, there were a few other adjuncts to learning, such as wax anatomical or surgical models, wooden skulls for rehearsal of trepanation, and osteological specimens. Finally, the aspiring surgeon would take an examination at a licensing corporation, viz. the Royal College of Surgeons of London (later England), Edinburgh, Glasgow or Dublin. At the English College, the examinations were held usually once a week, and a Master, two Wardens and seven members of the Court of Examiners sat around a table and two or three examiners talked to the candidate, or he might have to face the whole body of the Court.

![Figure 2: Examination of a surgical candidate at the Royal College of Surgeons of London – Cartoon by George Cruikshank (1792-1878) (courtesy of the Royal College of Surgeons of England)](image-url)

After due conference the candidate was informed that he might be successful or he was to be referred. A certificate was awarded and the candidate progressed into practice at a hospital or in the community. Alternatively, he would apply to the Honourable East India Company, Royal Navy or British Army. If the latter course were chosen, the young surgeon would go to the Sick and Hurt Board of the Admiralty or the Board of the Army Medical Department in Berkeley Street in London. There he would be further quizzed and appointed to a regiment, hospital or ship.
We have to consider next the tools used by the surgeons. Front line surgeons required bandages, water and a pocket set of instruments.

Figure 3: Royal Naval presentation set of pocket surgical instruments 1808 (courtesy of the Royal College of Surgeons of England)

This contained bistouries (long-bladed scalpels), probes, forceps, abscess lancets and a seton (an instrument to pass a skein of threads through the tissues, to promote counter irritation). Many officers and NCOs in the Royal Navy and British Army were encouraged to carry tourniquets into action.

Sets of instruments contained in large, brass-bound oak or mahogany boxes were carried by medical officers in civilian and military practice. These provided equipment to perform amputation, trepanning, exploration of wounds, drainage of sepsis and, later in the 19th century, dental instruments. Mounted surgeons could pack amputation sets into saddle bags.
There are interesting details of construction in some surgical tools; self cleaning teeth on saw blades, with channels to allow passage of bone dust, take-apart instruments, to allow cleaning of the joints, and sets which contained a few handles made of organic material (e.g. ebony), which might fit several varied instruments, e.g. trephine heads, skull perforators and lenticulars (instruments for scraping and trimming ragged skull bone edges).

What could be achieved surgically? Firstly, there was no pain relief in the form of anaesthesia. Surgery was mostly performed, for good ergonomic reasons, in the upright position and alcohol was not prescribed, since although it might possess anxiolytic properties, it was not an analgesic and could encourage haemorrhage and result in poor cooperation. The following table illustrates the varied types of procedure carried out by civil and military surgeons.
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<td>Drainage of sepsis</td>
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Table 1: Civilian and military surgical procedures

In peacetime, fractures, soft tissue injuries and infections were more common than cancers and arterial disease – many patients not surviving long enough to suffer from the latter two problems. During combat at these times, an analysis had shown that two thirds of casualties presenting alive to surgeons on the battlefield were caused by small arms fire, whilst only 17% of wounds were inflicted by ordnance (artillery). This ratio was reversed in casualties in the navy – around two thirds of wounds were inflicted by cannon shot and only 13% by musket, blunderbuss and pistol.

As to surgical techniques, French texts of the mid 19th century illustrate the method of holding instruments for incisional and excisional purposes.
Figure 5: Technique for holding a bistoury (from Bourgery JM and Jacob NH - *Atlas of the Human Anatomy and Surgery – colour plates of 1831-1854*). (Author’s Collection)

Tissues were incised to facilitate removal of foreign material, for release of pus and to relieve tension. Excisional procedures included amputation and removal of tumours or granulations. Another problem with surgery at these times was that surgical access was limited to small incisions and confined approaches to pathology.

Repair of tissues and removal of buried foreign material demanded digital exploration of a wound, followed by probing with a malleable probe and retrieval of missiles or shards of debris using various types of forceps. Primary repair with sutures was usually attempted. Sadly the practice of wound exploration, debridement and secondary repair would not come into widespread use for another 100 years. Fortunately primary repair of damaged tissue was often hindered by swelling, caused by bruising and oedema.

Limb ablation was one of the most capital (major) procedures carried out in both civil and military practice. Civilian amputation was often performed for sepsis (including tuberculous joint infection), but the removal of limbs in the armed services was more frequently carried out for trauma.
The decision to amputate for trauma was based on the amount and type of soft tissue damaged and vascular and joint injury. Post injury or surgical sepsis was often a later indication – delayed amputation carried a significantly higher mortality. During the passage of the 19th century, ablative surgery became more conservative, with, for example, disarticulation at the shoulder being replaced on occasion by removal of a damaged head of the humerus.

Usually the patient was supported in the upright position, to allow rapid and easy access to the damaged limb. For lower limb surgery, the patient would sit at the end of a sturdy table and be supported and restrained from behind. The normal limb would be held, as would the damaged leg. The surgeon would normally stand near to the limb to be removed, whilst there was an assistant to control the padded tourniquet or compress the feeding and principal artery. There was a transition during this period from performing a guillotine amputation and forming soft tissue flaps to cover the bone end.

Figure 6: Flap formation during amputation (from Bourgery and Jacob). (Author’s collection)
With the former technique, more speedy and requiring less skill to carry out compared with the latter, the divided bone would be difficult to cover with inadequate soft tissues.

For the guillotine operation, a tourniquet was first firmly tightened to ensure an avascular field of surgery. The skin of the limb, just above the proposed incision, was stretched down and divided with a rapid, firm circular sweep of the capital knife, which was normally curved or semi-curved (‘Coup de Main’). Successive sweeps through the thick muscles at progressively higher levels helped achieve just enough skin, fat and muscle to pull over the divided bone (‘Coups de Force’). The bone was then severed by a tenon saw and, as far as possible, splintering was avoided. The divided soft tissues had to be retracted out of the way of the saw blade by pulling them out of the way with a linen (or leather or tin) retractor.

Figure 7: Mid thigh amputation – incisions and retraction of soft tissues. (from The Great Operations of Surgery). (Author’s collection)

The arteries (not the veins as a rule) were taken up with a tenaculum, Assilini or sliding catch forceps.
The vessels were ligated with linen or silk threads and the tourniquet slackened to visualise any bleeding. This could be retightened and further haemostasis performed should it be necessary. The ligatures were left long and hanging out of the wound, to be pulled off in 10-14 days. Around this period, some surgeons suggested and practiced cutting the ligatures short, so leaving the knot (with inherent risk of peri-knot sepsis) buried in the depth of the wound. The wound was sponged dry and after pulling the wound edges together as firmly as allowed, these were kept approximated with adhesive tapes, sutures, or both. A linen or cotton pad applied over the wound was kept in place using a Malta cross bandage and around the four tails of this was rolled a linen bandage, applied spirally. Results varied with the skill of the operator, delay in the patient reaching the surgeon, and the site of the injury. Although there were a handful of survivors of disarticulation of the hip, this capital surgery carried almost 100% mortality. Digit amputation provided only a few per cent – in the main, from ascending sepsis or tetanus. The overall
mortality at all sites would be around 20%. Complications included bone end protrusion, sepsis, tetanus, pain and initially painful muscle spasms.

Skull surgery was in its infancy and during this century outcomes were often poor since the accompanying severe brain damage could not be treated and raising a depressed skull fracture or removing an intracranial blood clot might well be of little therapeutic benefit. During the wars of the early 19th century, the procedure of trepanning became more selectively used and was, in the main, applied for the management of depressed fractures of the skull. After a cruciate incision made through the skin, fat and muscle of the appropriate part of the head was made, the crown trephine or Hudson brace type skull saw was applied, having scraped away the adjacent periosteum. French surgeons tended to use the Hudson type brace and the British favoured the crown trephine. The disc of bone cut out by the saw was removed from the portion of stable skull nearest the fracture lines (Figure 9, site labelled ‘D’).

Figure 9: Trephining the skull – Illustrating the positioning of the bone excision (from The Great Operations of Surgery). (Author’s collection)
This gave access for the surgeon to inspect, prognosticate and treat the area of damaged meninges and brain and remove any compressing blood clot. Several discs might be cut out to improve access. If the patient survived, the bony defect would remain, occasionally protected by a prosthesis, such as a metal plate.

Urological surgery was in its infancy, and in both civilian life and the armed services a large proportion of patients with urinary tract problems suffered with venereal disease. Gonorrhoea and syphilis were thought to be differing stages of the same disorder and urethral strictures (sometimes traumatic) were often caused by STD. Bougies (from the French word for a candle) made from wax, soft metals or gum elastic, were passed to stretch up the stricture. Occasionally a caustic holder was introduced into the urethra to apply dilute mineral salts to the face of the stricture. Patients with prostatic obstruction or strictures frequently perished from urinary tract sepsis. Catheterisation could be risky and it was often difficult to retain the catheter. Sometimes, suprapubic or transrectal or vaginal trocars and cannulas could be inserted if there was impassable urethral obstruction. Cutting for the stone was an historic and ancient procedure, with occasionally remarkable survivals. At this time the lateral perineal approach was used. The urethral staff was introduced and the stone pushed down towards the rectum. The incision was made beside and in front of the rectum, through the perineum, the blade cutting right through the bladder base, into the bladder cavity. The stone was removed with large forceps and the wound merely dressed. Not surprisingly, bleeding, perineal sepsis, incontinence, impotence and poor wound healing often resulted.

Vascular surgery was required for control of bleeding following damage to or occlusion of a vessel – the knowledge of the safe approach to major arteries was an essential for the 19th century surgeon. Vessels could be ligated proximally in the case of aneurysm and during these times it was appreciated that the surgeon must ligate above and below a vessel wound by a penetrating weapon or missile.

Whilst a completely divided artery could contract and often cease bleeding, a partially damaged vessel would not – this was recognised. Collateral circulation was often insufficient for the survival of a limb following major vascular ligation and dry or moist gangrene frequently dictated a mortal outcome for the patient. Sutures and ligatures were usually made of linen, silk or dental silk – cotton threads were too short for sufficient strength.
It was the case, about the turn of the 18th century, that around 14% of adult males in England had a groin hernia. There was no definitive repair surgery for hernia, so the treatment was aimed at the management of emergencies only – i.e. irreducible, strangulating hernia. The operation was termed herniotomy and merely achieved release of the constricting element that was compressing the portion of bowel trapped in the hernial sac, so embarrassing its blood supply. If this latter situation persisted, then the bowel segment would become gangrenous, slough off and faecal peritonitis or, if the patient was ‘lucky’, a faecal fistula might result.

For the operation of herniotomy, the skin would be incised with a bistoury or scalpel and a blunt tipped hernia bistoury would be insinuated under the constricting band and the latter cut, so releasing the tension. For those with asymptomatic hernias, trusses of one sort or another were prescribed.

Figure 10: Site of ligation of some lower limb arteries (from Bourgery and Jacob).
Accessible tumours of the skin, breast, tongue, lip or genitalia were excised and bleeding was controlled by suture and bandage. Polyps of the nose, vagina, rectum or skin were snared or excised. Abdominal and thoracic surgery was limited by lack of anaesthesia, antisepsis, muscle relaxants and appropriate physiological support for the post-operative patient.

The reprehensible practice of bleeding (venesection) and minor surgical interventions for counter irritation were of little but placebo value to most patients and would gradually fade as the 19th century wore on. Venesection was originally practised in accord with the humoral theory of disease, but later was thought to be an essential part of the antiphlogistic (anti inflammatory) regimen, to prevent the very onset of sepsis.

Figure 11: A portion of bowel with impaired blood supply awaiting release by herniotomy (from The Great Operations of Surgery).
Surgery at these times was inevitably a nightmare, but often patients were just driven insane with pain, repeated attacks of sepsis, deformity, or the threat of death so the option of an agonising hour of surgical intervention and many weeks of complicated recovery seemed preferable to certain mortality. It is hard for us to imagine the suffering of such surgery by those who had no expectations of what advantages we possess today. To comprehend a little of the discomfiture of limb ablation we can only read of an account of an amputation carried out on a 24-year old surgeon, George Wilson, by James Syme in 1843. He wrote, “Of the agony it occasioned, I will say nothing. Suffering so great as I underwent cannot be expressed in words, and thus fortunately cannot be recalled. The particular pangs are now forgotten, but the black whirlwind of emotion, the horror of great darkness, and the sense of desertion by God and man, bordering close upon despair, which swept through my mind, and overwhelmed my heart, I can never forget, however gladly I would do so.” He continued, “I still recall with unwelcome vividness the spreading of the instruments, the twisting of the tourniquet, the first incision, the fingering of the sawed bone, the sponge pressed on the flap,
the tying of the blood vessels, the stitching of the skin, and the bloody
dismembered limb lying on the floor.”

During the workshop, contemporary instruments and images were
passed around the audience. The general conclusions were that although
the surgery was primitive, there were technically very able clinicians,
who were constrained by the lack of control of both pain and sepsis.

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