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Advances in surgery under the Second French Empire of Napoleon III (1852–1870)

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Summary
Background After the February Revolution in France in 1848, Louis Napoléon Bonaparte, the nephew of Emperor Napoleon I, became the first President of the French Republic. On December 2, 1852, Louis Napoleon Bonaparte proclaimed the Second Empire by becoming Emperor of the French under the name of Napoleon III. This period corresponds to the Industrial Revolution in France, marked by notable medical advances that allowed surgery to also enter into the modern era.
Methods In this historical study, we assessed the surgical advances during the period of the Second Empire until 1870.
Results We detailed the implementation of general anaesthesia in surgical procedures as well as the uncertainties it caused in its beginning and the efforts led by the surgical community to reduce the rate of postoperative infections, but also the technological advances of the industrial era leading to the discovery of surgical haemostasis.
Conclusion This study highlights the work of the greatest French surgeons who practiced under the Second Empire of Napoleon III, a period which saw the birth of modern surgery in France.

Data Statement Data will be shared upon request from any qualified investigator.

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Main novel aspects

- The Second French Empire corresponds to the Industrial Revolution marked by notable medical advances that allowed surgery to also enter into the modern era.
- The implementation of general anaesthesia allowed a real revolution in the method of carrying out a surgical intervention and allowed the realization of new types of procedures.
- One of the main advances of this period was the large number of works carried out to reduce the rate of postoperative infection.

The historical context

France experienced its third revolution in 1848, the so-called February Revolution, which put an end to the constitutional monarchy of Louis Philippe I and the establishment of the Second French Republic with the election of Louis Napoleon Bonaparte, nephew of Emperor Napoleon I. Four years later, Louis Napoleon Bonaparte proclaimed the Second Empire by becoming Emperor of the French under the name of Napoleon III (Fig. 1). This period corresponds to the Industrial Revolution, with major national efforts to modernise France. The care given to the population was one of the main concerns of Napoleon III, who created the Assistance Publique—Hôpitaux de Paris in 1849, the largest university hospital centre in Europe, in order to be able to treat the underprivileged population of Paris. The reign of Napoleon III allowed notable medical advances that allowed surgery to also enter into the modern era.

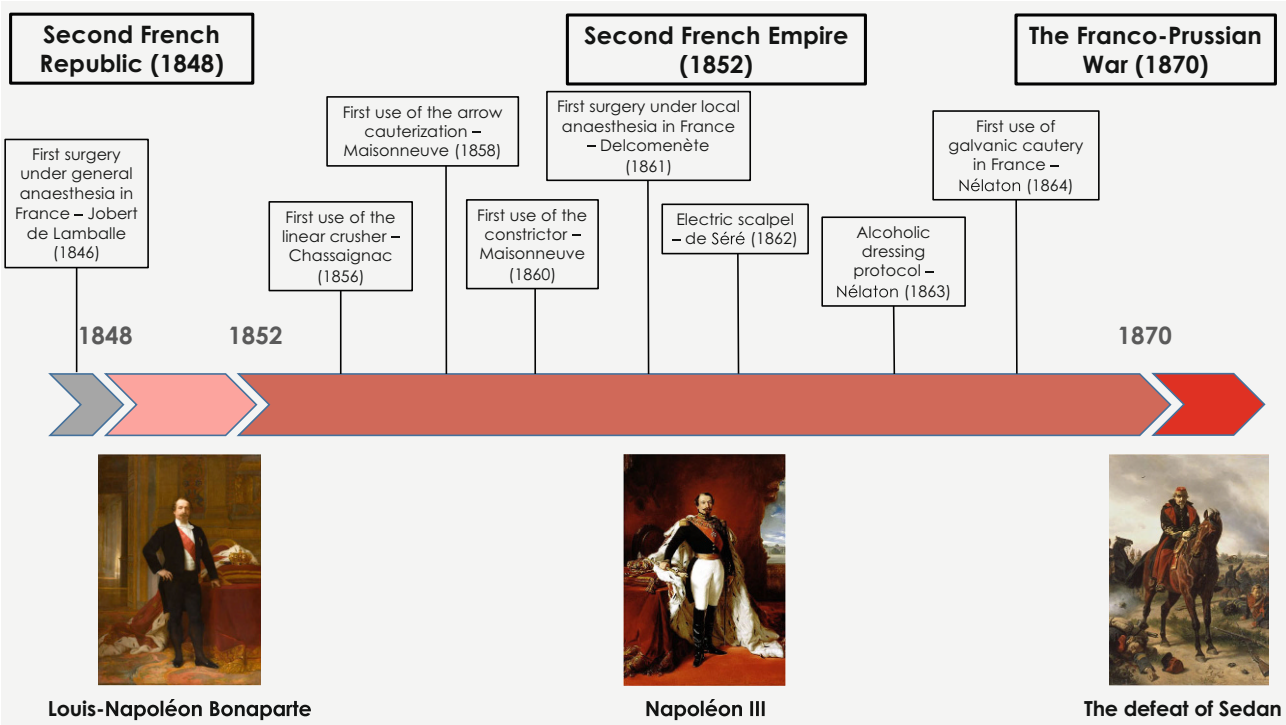

Fig. 1 Timeline from the Second Republic to the end of the Second Empire (1848–1870)

Anaesthesia, the basis of surgical progress

The first surgical intervention under general anaesthesia was performed on September 30, 1846, in Boston by William Morton, a North American dental surgeon who performed a dental extraction using ether as an anaesthetic [1, 2]. Although the inventor of anaesthesia is still unclear between William Morton, Charles Jackson, and Crawford Long [3], its realisation is of trivial importance for the progress later held in surgical practice [1]. Francis Willis Fisher, a young 25-year-old American surgeon, presented this general anaesthesia procedure to Antoine-Joseph Jobert de Lamballe, first surgeon of Napoleon III, at Saint-Louis Hospital in Paris [4]. Thus, the first French surgical intervention under general anaesthesia with ether was performed on December 15, 1846, by Antoine-Joseph Jobert de Lamballe, who performed the resection of a cancer of the lower lip in a 59-year-old man [5].

Surgeons applied themselves to optimizing the anaesthesia procedure and invented new etherisation devices [6]. By chemical analogy, other agents were developed in the following years, such as chloroform [7], amylene [8], acetone or aldehyde [6]. In parallel with the work of Johann Nepomuk von Nussbaum in Germany, it was Claude Bernard who, in France, was the first to propose the "mixed" or "balanced" anaesthesia procedure in 1860, which consisted of a subcutaneous injection of morphine followed by inhalation of chloroform [9]. He also presented a large number experiments on the toxic action of curare, a substance which abolishes motor activity without affecting sensory activity [10, 11]. This French physiologist allowed the improvement of the procedure of general anaesthesia with the use of morphine, and made important discovery on curare, which allowed its regular use in anaesthesia later on during World War II. These works were closely followed by Napoleon III and the Empress Eugénie, who received him in Compiègne in 1864. Napoleon III, impressed by his works, asked him to formulate a wish. Claude Bernard simply asked for the funding of an assistant. Napoleon III financed an assistant position and made Claude Bernard senator as a bonus [12]. Anaesthesia made it possible to obtain two very distinct states depending on the protocol used: 1) analgesia with preservation of intelligence, senses, and voluntary movement, used mainly in obstetrics [13]; and 2) mixed anaesthesia associated with loss of consciousness and myorelaxation [6]. The Second Empire was also marked by attempts at surgical interventions carried out under hypnosis with numerous failures, which quickly made this practice obsolete [6, 14]. Finally, this period saw the rise of local anaesthesia by different processes, such as that of the pharmacist Delcomenète of Nancy in 1861, who used pulverized carbon disulphide which was associated with considerable lowering of the temperature of the operated area [15], or the work of Jean-Nicolas Demarquay at Beaujon Hospital in Paris in 1855, and furthermore, that of Léon Labbé at the Salpêtrière Hospital in Paris in 1866 [6, 16].

Subsequently, rules started being established in order to frame the anaesthesia procedure such as fast-

ing, strict dorsal decubitus, and denudation of the patient in order to allow perfect monitoring of constants and integuments [6]. Alfred Velpeau was the first Frenchman to describe the main applications of the etherisation procedure in the treatment of traumatic dislocations for its analgesic and myorelaxant effects, and in obstetrics for childbirth [5].

Napoleon III himself benefited from lithotripsy under general anaesthesia in 1873 at the end of his reign in England, performed by Sir Henry Thompson, a British urologic surgeon [17]. He died after several unsuccessful attempts on January 9, 1873.

Purulent infection, a limit to progress

The frequency of surgical site infections was the main limitation to the progress of surgery during the Second Empire. To fight infections, many experiments on dressings were described: dressing with water or glycerine, use of Corne et Demeaux powder, iodine, ferric chloride, potassium chloride or even saponinated coal tar, which was of great success during the end of the Second Empire and during the Franco-Prussian War of 1870 [6, 14, 18]. The use of carbolic acid was acclaimed thanks to the work of Jules Lemaire, who presented his favourable results in 1861 at the Institut de France [11]. All these experiments carried out during the Second Empire allowed the emergence of a real art of surgical dressing. Nowadays, iodinated antiseptics are still used in current dressing protocols as well as in surgical preparation; however, no consensus emerged regarding the dressing protocol used, and each surgeon followed their own habit.

However, the unsanitary state of Parisian hospitals compared to those in the provinces, and the number of patients cared for in large common wards, did not make it possible to drastically reduce the "hospital rot" [19].

Emergence of antisepsis

The first advances that allowed a notable reduction in surgical site infections are attributed to Auguste Nélaton, a consulting surgeon of the Napoleonic imperial houses, who was the first to propose a protocol of impregnating dressings with alcohol (lint containing camphor brandy) in his service at the Hôpital des Cliniques in Paris. In 1863, he reported very satisfactory results, with an infection rate of only 7% [6].

Jacques-Louis Reverdin, from Geneva in Switzerland, tried epidermal grafting to cover purulent wounds that slowed the healing process [6]. He presented his positive results in 1869 at the Société Impériale de Chirurgie [20] and, despite a difficult start, this technique experienced significant growth, particularly under the Third Republic, thanks to the work of Aristide Verneuil and Louis Ollier [6].

At the end of the Second Empire, it was Just Lucas Championnière who, after having trained in Glasgow, proposed to import the antiseptic technique of Joseph Lister, a British surgeon, into France in 1876 [21]. This technique consisted of impregnating the hands of the surgeon, the hands of the assistants, and the skin of the patient with carbolic acid [22].

During the Second Empire, surgeons fought for the sanitation of their hospitals and succeeded in convincing Napoleon III of the construction of hospitals on a human scale, often in the outskirts of Paris, in order to limit the number of hospitalized patients [6]. During the reign of Napoleon III, 172 hospitals were built throughout France. Demolition of the historical Hôtel-Dieu was decided in 1861 by Napoleon III, who ordered its reconstruction and modernization between 1867 and 1878. The Lariboisière Hospital opened in 1853 thanks to one of the largest donations in French history from the Countess de La Riboisière, wife of the Count de La Riboisière, a grand officer of the Second Empire. These hospitals could reach up to 800 beds for the Hôtel-Dieu and 600 beds for the Lariboisière Hospital [6].

However, it was not until the work of Louis Pasteur, supported by Napoleon III, that antisepsis took hold in French hospitals in 1875, and a new era of surgery began [19]. Louis Pasteur, an ardent supporter of Napoleon III's coup d'etat, supported the Empire from the beginning. He said to his father in 1859: "no government has been as strong, I believe, as that of Louis-Napoleon today" [23]. Because of his talent, he quickly became chairman of chemistry in 1852, then dean of the Faculty of Sciences of Lille in 1854, and administrator of the École Normale in 1857. He was elected to the French Academy of Sciences mineralogy section in 1862. This election allowed him to personally encounter Napoleon III, who was presented to him in March 1863 [23]. He conducted his studies on the diseases of silkworms, which ravaged the sericulture industry in the south of France, from 1865 to 1869 at the request of Napoleon III and Empress Eugénie [23]. He was granted a chair at the Sorbonne by the emperor in 1867, in order to continue his work with significant technical, financial and human resources. Thus, the work of Louis Pasteur benefited from the institutional and financial support of the empire thanks to the admiration of Napoleon III for this illustrious scientist, who allowed his important discoveries on antisepsis a few years later.

Development of modern haemostasis

In 1856, Edouard Chassaignac developed his "linear crusher" (Fig. 2) in nickel-plated steel, whose alternating movements simultaneously sawed and crushed the concerned tissue [24]. With this instrument, he performed many ablations, the practice of circumcisions and amputation of the thigh [24]. He reported a lower rate of postoperative infection as well as a reduction in blood loss for major operations [24]. Jacques Maisonneuve developed the arrow cauteriza-

Fig. 2 The linear crusher of Edouard Chassaignac (1856). National Library of France

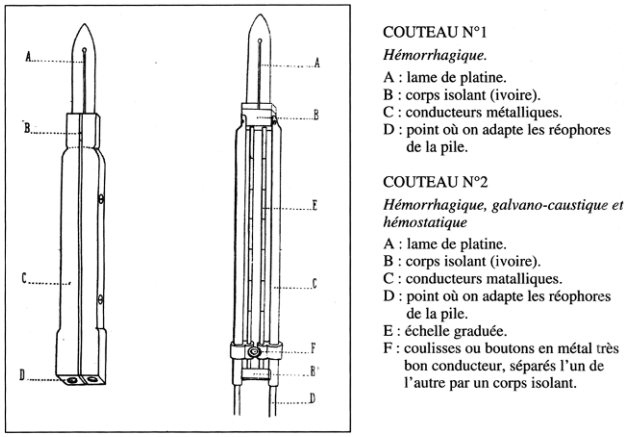

Fig. 4 The galvano-caustic knife without and with the graduated scale of Eugène de Séré (1862). French Interuniversity Health Library

tion procedure in 1858, and proposed percutaneous puncture of tumours with administration of a caustic product in order to perform local chemoablation [25]. This practice was not very successful for the surgical authorities of the time [6]. In addition, in 1860, Jacques Maisonneuve developed his "constrictor", which made it possible to perform "extemporaneous ligatures" to which he associated his "osteoblast" for so-called diaclastic amputations (Fig. 3; [26]). With this new instrumentation, Jacques Maisonneuve successfully performed a coxo-femoral osteotomy for the treatment of complete ankylosis before Auguste Nélaton and Victor Morel-Lavallée [27].

Parallel to these developments of thermal and mechanical haemostasis, the progress made during the Second Empire on electricity allowed the creation of galvanic cauterization. This process, described by the English chemist Humphry Davy in 1806 [6], used the properties of electricity to allow cutting and cauterization of tissue during a surgical procedure. In France it was Auguste Nélaton who introduced this technique in 1864, following the treatment of a voluminous hypervascular nasopharyngeal polyp using two electrodes inserted into the full thickness of the lesion [28]. The galvanic cautery method rapidly established itself as a first-rate haemostatic practice. In France it was Eugène de Séré who, in 1862, perfected the galvano-caustic knife (Fig. 4), the first electric scalpel, which was then widely used by Auguste Nélaton, Jean Demarquay and Jules Cloquet for amputation of the breast and treatment of pedunculated tumours mainly of the skin, airways and uterus [6]. The main improvement was the distinction between the cutting loop (1500 °C) and the haemostatic loop (600 °C), which made it possible to optimize surgical procedures [6]. Jean-Zuléma Amussat was the main promoter of this technique in France, who applied it to a large number of surgical procedures [6, 29, 30].

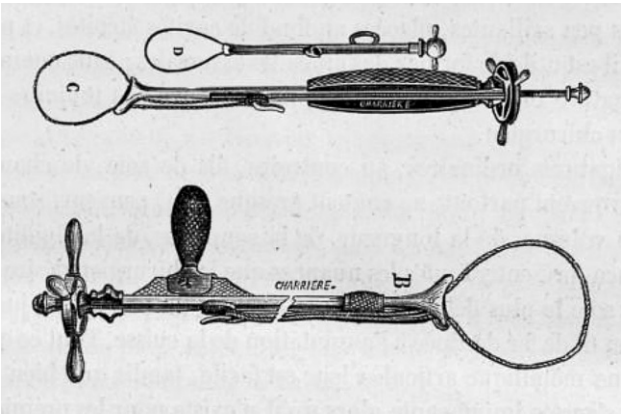

Fig. 3 The constrictor of Jacques Maisonneuve (1860). National Library of France. (*B* Large constrictor with its wire rope, *C* Medium constrictor with its wire rope, *D* Small constrictor or kit snare with a simple metal wire)

These haemostasis techniques, facilitated by the development of general anaesthesia and pain sedation, made it possible to carry out surgical procedures that had been considered too dangerous until then, by significantly reducing the risk of haemorrhage and reducing the duration of the procedure.

Conclusion

This study highlights the work of our masters who practiced under the Second Empire of Napoléon III, a period which saw the birth of modern surgery in France thanks to the rise of general anaesthesia, the beginning of operative antisepsis and control of haemorrhage. Unfortunately, progress in surgery remained hampered by the risk of infection, which is still poorly understood. It is thanks to the works of Louis Pasteur in 1875 that surgery experienced a major advance, bringing it closer to our current

procedures. In 1870, after the defeat of Sedan, Louis Pasteur told Marshal Jean-Baptiste Philibert Vaillant: "The emperor can confidently await the judgment of posterity. His reign will remain as one of the most glorious in our history".

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