Bleeding control in the past

From prehistoric times onwards, mankind encountered severe trauma with often fatal haemorrhage. Finger or hand compression has probably been the first means of controlling bleeding. Even prolonged compression proved not always sufficient, so other methods had to be found. One of these methods, blood vessel ligature, appears to have been practised by the Indian surgeon Sushruta, living between 800 and 600 B.C. He supposedly to have used hemp fibers to ligate the vessels (1).

Control of haemorrhage was also performed by applying a hot iron stick or boiling oil. To stop haemorrhage after bloodletting, Sushruta made use of cold substances to thicken blood, dried the wound with ashes, applied a styptic mixture on the vein or burnt it to make it retract.

Surgeons of Ancient Greece do not appear to have used ligature for control of haemorrhage. However, they did apply various styptic substances (verdigris, antimony and lead sulfate) directly to bleeding wounds. A “haemostatic button” or circular wad of copper sulfate was also used with this purpose (2).

During the Roman period, the renowned medical compilator Aulus Cornelius Celsus describes the treatment of haemorrhage in his “De Re Medicina”, written about 30 A.D., the use of linen pledgets soaked in cold water and compressed into the wound. If this failed, vinegar was to be applied. In the worst situation, Celsus instructed that cautery had to be used or that the bleeding vessel should be taken up and ligatures should be applied above and below the wounded part. About two centuries later, Rufus of Ephesus detailed several ways to treat haemorrhage. These included compression, styptics, cautery, ligature or twisting arteries to occlude them (3).

During the Middle-Ages, the technique of ligature got abandoned, while cauterization got popularized through Arabic influences. Hot iron, boiling pitch, oil and molten lead became the most accepted methods for haemostasis.

As a result of the lack of boiling oil during the campaign of Piemont in 1536, the French army surgeon Ambroise Paré (4) reintroduced conservative measures like drugs and ligature. In his surgical practice he made use of a “raven’s beak” forceps (Fig. 1), a self-created instrument employed, among other things, to catch hold of the arteries to ligature (5).

In the 17 th century, a new instrument, the valet à Patin (6), exclusively used to grab the arteries appeared. These artery pliers were made of two hinged branches fitted with a spring to keep the instrument closed. They remained in use till the end of the 18th century, when they were replaced by Bell’s tenaculum (7) (Fig. 1).

**Surgical history**

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**History of Instrumental Haemostasis and the Particular Contribution of Jules E. Péan**

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(1) Friedman, p. 1.
(2) Ibidem, pp. 3-4.
(3) Ibidem, p. 4.
(4) Ambroise Paré (1510-1590) was born in Bourg-Hersent near Laval (Mayenne, France). From a simple barber-surgeon, he became the successful surgeon of Henry II, Francois II, Charles IX who took good care of saving him from the “massacre of St. Barthélemy”, and Henry III. Paré is considered as the father of modern surgery.
(5) The raven’s beak could be considered as the first specific artery forceps. It was invented and designed by Ambroise Paré. An illustration of this forceps is included in his treatise of surgery published in 1565. The instrument was fit to recover and draw the vessels from the flesh wherein they had retracted, in order to tie them or bind them fast.
(6) The invention of the valet à Patin or artery pliers is attributed to Gui Patin (1602-1672), a physician and professor of surgery in Paris from 1632. In his “Nouveau traité des instruments de chirurgie les plus utiles”, Garengeot doesn’t agree with that fathership. The French word valet was given to this instrument fitted with a spring which clamped the vessels tight, substituting the task of the surgeon’s assistant or the surgeon himself.
(7) Henry, p. 46.
To reduce bleeding in case of amputation, Ambroise Paré suggested to place a tightly pressed cord around the limb which made prolonged compression less tiring for the aids. A more suitable method consisting of a buckled ring to belt the limb, was invented before 1634 by the German surgeon Wilhem Fabry von Hildern (8).

In 1674 the French surgeon Etienne Morel first used a field garrotte to stop haemorrhage from a wound made to a soldier at the siege of Besançon. This device was a simple cord without pad, tightened by twisting one or two wooden rods, placed under the loop (9). Later on, a rather wide pad and ivory plate attached on either side under the rods were added to Morel’s garrotte to make compression more efficient and comfortable.

Around 1718 another French surgeon, Jean-Louis Petit, introduced an easier and safer screw compressor device named by him “tourniquet à vis”. This screw tourniquet (10) (Fig. 2) was initially made of wood, later of brass, incorporating a pad precisely over the main vessels, so compression on the limb was made only on two diametrically opposite points. Several models of mechanical ratchet tourniquets were then perfected without bringing any advantage with regard to Petit’s initial model (11).

Besides amputation, prolonged arterial compression was equally used to treat aneurysms or control bleeding of specific injured arteries. With the knowledge of this therapeutic appliance and to compress arteries inaccessible or inefficient to conventional tourniquets, a set of mechanical ingenious compressors (Moores’s, Lampe’s, von Graefé’s, Dupuytren’s, Charrière’s, Bourgery’s, Broca’s compressors) were produced in the workshops of several surgical instrument manufacturers from the end of the 18th century till the second half of the 19th century (12) (Fig. 3). Unfortunately, some of these compres-

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(9) Thompson, p. 85.
(10) The screw tourniquet remained in use until World War I.
sors were expensive and excessively complicated resulting in poor bleeding control and easy dislocation by the patient’s movements (\textsuperscript{13}).

The \textit{pinçette} or spring-forceps, the surgeon’s indispensable instrument in his daily practice, could be used to grasp arteries in order to ligature them (Fig. 1). They were also used for depilation, to take off dressings or to extract foreign bodies from the wounds (\textsuperscript{14}). At the end of the 17\textsuperscript{th} century, Dionis (\textsuperscript{15}) described and showed them with a surrounding ligature in his famous work entitled “\textit{Cours d’opérations de chirurgie démontrées au Jardin Royal}”. These most common forceps, according to Dionis, had to be kept by the surgeons in a case everywhere they went. For the same reason as the \textit{valet à Patin}, this ancestor of the forceps later became called “haemostatic forceps”.

The forceps described by Dionis, of which branches are kept open by the spring system, evolved later on and in 1787, Desault advocated the use of an artery compression forceps which differed from the previous ones by its spring mechanism, which closed the jaws and held their grip (\textsuperscript{16}). In case the application of a necessary ligature had failed, Desault devised a method of placing the bleeding artery between two small wooden palettes and compressing them by means of a cord. In 1805 Percy (1754-1825) substituted the wooden palettes for small lead plates, while Assalini (1759-1840) from Milan introduced spring forceps with small quadratic plates for arterial compression (\textsuperscript{17}).

In his work dated 1825, Sir Henry, the cutter of the \textit{Chambre desPairs de Paris} (\textsuperscript{18}) shows a slide forceps next to a \textit{tenaculum}, both instruments invented by Benjamin Bell to control arterial bleeding, respectively in 1790 and 1807. Until the middle of the nineteenth century, the \textit{tenaculum} was in general use by surgeons and indeed, in 1873, Lister testified that this instrument had universally been employed since a long time. However the \textit{tenaculum} had meanwhile been superseded by the catch forceps introduced by Robert Liston in 1847 (\textsuperscript{19}). This catch forceps could be closed by a rack or a slide-catch mechanism (Fig. 1).

A few years earlier, in 1840, a new era in the history of the artery forceps was inaugurated by Joseph Frédéric Charrière (\textsuperscript{20}) from Paris who introduced a crossed-legged instrument which operated as a clamp corresponding to the original \textit{serres-fortes} of C. E. Sédillot.

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(13) Kirkup, p. 49.
(14) Dionis, pp. 26,626 and plate XLVII.
(15) Pierre Dionis (1643-1718), the king’s surgeon entrusted with the chair of anatomy at the \textit{Jardin Royal}, was one of the most famous leading Parisian surgeons of the 17th century.
(16) Thompson, p. 68.
(17) Ricci, p. 486.
(18) Henry ou Sir Henry was one of the most renowned cutlers and surgical instrument makers in the first third of the 19th century. He was famous for his damasked steels. He is the author of a ‘\textit{Précis descriptif des instruments de chirurgie anciens et modernes}’ published in Paris in 1825, that includes numerous surgical instruments.
(19) Thompson, pp. 68-69.
(20) Joseph-Frédéric Benoît Charrière (1803-76), one of the most remarkable medical instrument makers of the 19th century, was born in Cerniat (Fribourg, Switzerland) and died in Paris. He was able to create the finest quality instruments to meet the requests of new knowledge and techniques, being the first to introduce German silver or maillechort in the making of surgical instruments. Like any great instrument maker, he was more than simply a technician, executing the design of others : in the field of lithotripsy, for example he worked with surgeons such as Civiale, Leroy d’Etiolles and Ségalas to produce innovative instruments. His instruments gained worldwide recognition and obtained many medals at international exhibitions : after the Universal Exhibition in London in 1851, Charrière became \textit{Officier de la Légion d’Honneur}. After the sudden death of his son Jules in 1866, the business was taken over by Adolphe Collin and Robert, two co-workers of Charrière, who published their first catalogue in 1867. Robert then left the company, which continued as Collin & Cie until 1930, when it became part of Gentile’s.
crushing or constriction of tissues in anaesthetized patients.

One of those instruments was Chassaignac’s écraseur. In 1850, in a session of the French Société de Chirurgie, Chassaignac (1804-1879) presented an instrument made by Mathieu in Paris (25), consisting of a chain, that by alternate motions simultaneously squeezed and sawed the tissues (Fig. 4). Chassaignac

In 1846, the discovery of inhalation anaesthesia would enable longer and painless operations, disclosing organs that were hitherto judged inaccessible (20). Despite the considerable progress that anaesthesia brought about in surgery, operative mortality remained high because of bleeding and infectious problems. Without comprehension of the infectious agents, often transferred from the autopsy room to the operating theatre, surgeons at that time proposed the most diversified causes to explain the surgical sepsis. To avoid infection, it was highly recommended to prevent the mysterious poison to get into the vessels. Only the so-called “obliteration” methods could bring up some healing chances by ensuring a hermetic vascular closure (20). This theory was at the origin not only of the important reintroduction of chemical cauterization, but also of the invention of rather scaring new instruments that induced progressive

(1804-1883) and modified by J. F. Dieffenbach (1792-1847) in Germany. In 1848 A. T. Vidal de Cassis (1803-1856) introduced what he called the serres-fines, very small light crossed-legged artery pincers made of wire with a spring resembling a safety pin (20). According to the artery instrument used, it remained however necessary – to ascertain a permanent haemostasis – to practise a twisting (22) or more generally to apply a ligature of the artery.

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(21) Ricci, p. 486.
(22) Twisting of arteries was introduced by the Parisian surgeon J.Z. Amussat (1796-1856). It consisted of twisting the vessel seven to eight times on its axis with a specific sliding-forceps called pince à torsion. The multiple twists of the vessel induced its occlusion by damaging the vascular layers.
(23) Désiron, pp. 490-493.
(24) de Fourmestraux, pp. 166-167.
(25) Louis Mathieu (1817-1879) was a surgical instrument maker and inventor, who was born in Belgrade (Namur, Belgium) and died in Paris. Son of a simple forge owner, Mathieu was very early initiated to the iron technique, and from the age of 14, had a training practice at the cutlery fabric of Gembloux (Namur, Belgium). He continued his apprenticeship in making surgical instruments in Germany and in Paris. There, around 1847, he founds his own manufacture and thanks to his skills and his narrow contacts with great Parisian surgeons, he soon created numerous instruments, that quickly became very successful. From 1849 onwards, Mathieu attended the principal national or international universal exhibitions (Paris 1855, London 1862, etc.) where he got several medals. In 1863, he was made Officier de la Légion d’Honneur by Emperor Napoleon III. His fame in Paris was considerable. After L. Mathieu’s death, his two sons R. and H. Mathieu succeeded him.
asserted that by using this instrument, bleeding was reduced and wound closure was faster, so that a new method preventing blood loss, even in the most serious surgical operations, was born (26).

**Dr Péan’s contribution to surgical haemostasis**

The citation of Chassaignac brings us to Jules Emile Péan (1830-1898) (Fig. 5) (Fig. 6). Indeed, in 1853, Péan was a second year medical student at the *Hôpital Lariboisière* in Paris. Although he was attached to Bourdon’s department, it is very likely, according to J. de Fourmestreaux, that young Péan sometimes left his duty to attend Chassaignac’s lessons in the nearest wards (27). Chassaignac was then a surgeon in that hospital and communicated his students his enthusiasm for the sovereign properties of his *écraseur*. This leads us to think that those privileged moments spent with the inventor of this amazing instrument boosted Péan’s interest and care for high-quality haemostasis in surgery. After a stay at the *Hôpital Saint-Louis*, then in a maternity department, Péan became a surgical resident in the department of Nélaton. In July 1862, the latter who performed one of the first ablations of an ovarian cyst in France, had undoubtedly the opportunity to share with Péan his interest for the surgical treatment of ovarian tumours, that was particularly discredited for bleeding

(26) de Fourmestraux, p. 167.
(27) Ibidem, p. 163.
mortality by the surgeon Velpeau some years before. On the other hand, Péan certainly knew that Koeberlé had performed his first ovariotomy in Strasbourg one month before Nélaton’s achievement. That was probably enough for Péan to successfully attempt himself the same procedure in 1864 (28).

The rather deep position of the female organs didn’t make it possible to carry out satisfactory haemostasis with a sliding-catch forceps or Sédillot’s serres-fortes, so that it was necessary to use a serre-nœud, a Backer Brown’s clamp or an écraseur. Those instruments were however unpropitious to simplify the operative technique (29).

The simplification of surgical haemostasis specially during gynaecologic surgery went through the utilization of pinion-catch dressing forceps, that was invented by Charrière in 1858 and of which the secondary function was gripping arteries, as mentioned by the surgical instrument maker in his catalogue (30).

First Koeberlé, then Péan discovered this forceps, since then called haemostatic forceps. Both considered them very useful and claimed their authorship until their death. The particularity of this forceps was that it could be left in situ for several hours or days, and once taken off, rarely needed a ligature (31).

Both rivals made the forceps modify at their own request by famous surgical instrument makers. Koeberlé appealed to Elser in Strasbourg in 1865 and in 1868, Péan asked Guéride in Paris to make him ring forceps and ratchet forceps identical in their principle but still more handy than Koeberlé’s, since the stopping of the two branches was operated by two easy to handle pinion catches. From that date on, those forceps were called pinces de Péan in the instrument catalogues, first that of Guéride and some time later, that of Mathieu (32).

Fig. 11
A big model of pince à mors longuet for crushing the ovarian pedicle (from Péan’s original case).

Fig. 12
Detail of Dr. Péan’s engraved mark on his custom made surgical case.

Fig. 13
A pastel etching of Dr. Péan performing a pharyngeal operation by his friend H. de Toulouse-Lautrec in 1891. Sterling and Francine Clark Art Institute, Williamstown, Massachusetts, USA. Notice the surgical instrument in Dr. Péan’s right hand could be a haemostatic forceps.

(30) Didier, p. 113.
(31) Ibidem, p. 117.
Péan diversified the models of the forceps with different jaws and had all these modifications made after his original forceps. In his work entitled “Du pincement des vaisseaux comme moyen d’hémostatise”, Péan described his technique and depicted his different models of haemostatic forceps. He had also long forceps made with right and strong jaws that he called *pince à mors longuets*. They were preferably used for vaginal hysterectomy, pioneered by Péan (33). In 1875, Verneuil (1823–1895) another Parisian surgeon introduced the term *forcipressure* – instead of *pincement* – and, as Péan had already proved before, concluded that instrumental crushing or *forcipressure* alone was sufficient to produce permanent haemostasis (34, 35).

### Dr Péan’s antique surgical case

In the beginning of the year 2006, I had the opportunity to discover an antique case of surgical instruments made by Mathieu in Paris, exclusively consisting of haemostatic forceps of diversified sizes and shapes. In the middle of the upper part of the lid of this large-sized black leather-covered wooden case, the name of Dr PEAN was mentioned. This exciting discovery in a private Belgian collection led me to investigate and describe this unique case.

The case is really impressive by its large dimensions. It is 69 cm long, 37 cm wide and 7 cm high (Fig. 7), and weighs 8.4 kgs. The outer surface is covered with black leather, while the inner part is lined with violet-coloured chamois leather. The case initially included 67 nickel-plated steel forceps (Fig. 8). The 45 remaining forceps are all marked by Mathieu. A panel separates the forceps and keeps them in position in both compartments. On this panel, in the right upper corner, appears the lettering *Mathieu, 113 Blvd. St. Germain, Paris*. The panel is locked by two stop-pins and by one bolt also signed *Mathieu Paris*. This signature also appears on the head of the lock. Among the forceps of this case are the Péan’s classical haemostatic forceps straight and curved on the flat part of the branches (Fig. 9). We can find several other forceps of increasing size and different shape including angulated, rounded, pointed, serrated jaw forceps (Fig. 10) as well as strong long forceps corresponding to the *pinces à mors longuets* quoted above (Fig. 11). In short, a whole series of exclusively haemostatic and crushing forceps necessary for the surgical operations Péan daily practised.

An underlying characteristic is that this case is *intaglio* engraved with ‘Dr PEAN’ in capital letters on the outer face of the lid (Fig. 12). The striking size of this case, the number of instruments, all signed, the gilt brass hinges and lock could make us think of a special case from the house Mathieu intended for an important exhibition, but the presence of spots and old blood stains on the chamois leather proves the surgical use of the forceps, embedded in this precious case. The portable case initially had a handle that is now absent.

These several factors tend us to believe that this case was Péan’s own case that he carefully used to carry along with him to hospital or any other place where he had a surgical intervention.

The accurate dating of the case is difficult. Péan appealed to Mathieu’s manufacture (36) for this custom-made case. Mathieu’s manufacture in Paris had moved at least 3 times since its creation. When Louis Jacques Mathieu died in 1879, the manufacture was taken over by his sons and was located 46, *Carrefour de l’Odéon*. About 1904, the manufacture was taken over by Schaerer, located Bld. St.-Germain. Yet the case is signed by Mathieu, 113 Boulevard Saint-Germain (Fig. 8). This is undoubtedly Mathieu’s last address. We can thus date the making of the case approximately between 1880 at the earliest and 1898, the year of Péan’s death, at the latest.

This case, unknown up till now, is a unique patrimony of the history of surgical instruments, and adds a concrete contribution to the role Péan played in improving 19th century haemostatic surgery and in spreading his method in France as well as abroad. Even if Péan did not really invent the haemostatic forceps, he systematized their use by multiplying models and technically improving them (37).

His fame acquired during lifetime was not only linked to the haemostatic forceps. Is it necessary to recall that Péan achieved several world *premières*, among others a splenectomy (1867), a resection of pylorus and antrum in gastric cancer (1879) and a resection of a shoulder distorted by tuberculosis, followed by its replacement by a hard rubber prosthesis (1890) (38). Moreover he was pioneer in France in the use of surgical aseptic and antisepsic methods (39). He was also the first in the world to perfect a steerable aluminium operating table driven by a jack, which became the pride of the *Hôpital Saint-Louis* (40).

When Péan retired from this hospital in 1893, he was rich and famous and had the *Hôpital International* built

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(33) *Ibidem*, p. 115.
(35) Kirkup, p. 274.
(36) It was not the first time Péan appealed to the House Mathieu for the making of specific surgical instruments. In *Eléments de Médecine Opératoire*, published in 1875 in Paris, Dubreuil shows two instruments, a *pince-scie* of Péan and a Spencer Wells’s trocar modified by Péan, both of them made by Mathieu.
(37) Braquet, p. 43.
(38) Didier, pp. 101-108.
(39) *Ibidem*, pp. 131-134.
(40) Braquet, p. 43.
with his own money. As proof of his generosity, Péan operated only impecunious patients without claiming any fees (41, 42). He operated until the end of his life and abruptly died of pneumonia contracted at hunting in 1898. Péan was given imposing – almost national – funerals and his friend Henry de Toulouse Lautrec (43) (Fig. 13) was certainly present in the huge burial procession to pay a last tribute to the surgeon who contributed so much to surgery in general and to control of haemostasis in particular.

What happened to his precious surgical case after he died? If it was kept at his house, did his family and his heirs take care of it or did they bring it back to the Hôpital International, later named Hôpital Péan? Were the case and its forceps still used afterwards by another surgeon or did his case remain in an attic for years? Several questions without answer...

Eventually the case ended on a flea-market in Paris some 30 years ago and was bought by a foreign tourist who took good care of it, before passing it to his son. As the latter couldn’t comprehend the importance of it, he decided to sell it on a German auction-sale website.

Since then, the case has been restored and carefully treasured by a medical antique collector, thanks to whom we are today delighted to reveal the existence of this unique surgical heritage.

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(41) Ibidem, p. 46.
(42) Didier, p. 216.
(43) Braquet, p. 44.