

Haemostats

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A haemostat is an instrument employed in arresting or helping to arrest arterial or venous bleeding. The principal instruments used today for this purpose are artery or diathermy forceps. A brief history showing how these instruments were evolved makes fascinating reading.

For centuries, man has known that bleeding could be arrested by the application of a firm pad under pressure or, in some instances, by pinching a small vessel between a finger and thumb and holding it for a while. The latter is an early example of "crushing" during which the walls of the arterial or venous vessel impinged together, coagulated and sealed of their own accord. It will be appreciated that, when several vessels had to be "stopped" in this manner, the process was prolonged and not always satisfactory. Surgeons needed a quicker way and for sheer speed, and what we would today describe as diabolical cruelty, nothing was quicker than the ugly cautery iron or the application of boiling oil. Cautery irons were designed to adapt themselves to the contours of the flesh. A round cup would fit over an amputated stump, a flat or probe instrument would search into a wound. Wherever the hot iron was applied the bleeding ceased, sometimes to recommence, necessitating a second application. One wonders which was the most painful, the oil or the iron?

Ligatures were known in very early times but were not always accepted because many surgeons held the view that sepsis of wounds was caused by ligatures. Many early records have been destroyed so we have no conclusive evidence which fully describes the instruments used by the early surgeons. We do know that forceps were used throughout the Roman Empire. The forceps of that day were used mostly by ladies who wished to remove unsightly hair from their bodies. Aristophanes and other humorists made naughty jokes about the use of these tweezers or forceps. It is logical to assume that the Physicians of that era also found uses for these instruments.

Ambrose Pare (1518-1590)—"The father of French surgery" was very concerned that men should suffer the torture of cautery and boiling oil, and felt that a better way had to be discovered. As an Army surgeon he had a great deal of experience and was an accepted authority. This gentleman, who had a weakness for puppy dogs' fat as a wound dressing, had taken for his motto "Je le pansay, Dieu le Gaurit" (I dressed his wounds, God healed him). Pare seems to have been among the surgeons who did not use ligatures, for we learn that he re-introduced ligatures when he invented his own artery forceps. Since there were no surgical instrument makers at that time and being, as we remember, an Army surgeon, it is almost certain that armourers made his first artery forceps. Pare's artery forceps resembled the pliers such as carpenters use today—they were just as clumsy. To intensify the grip on a bleeding vessel, Pare instructed his armourer to introduce an L-shaped clamp between the blades.

During the next 200 years artery forceps evolved through many states. One difficulty, commonly agreed, was that the forceps would not grip of their own account, they had to be held. An early advance of the locking type forcep consisted of a collar stud running through grooves cut into the blades of the forceps. The tip of the forcep gripped a vessel, the stud was pushed down the grooves and the forceps locked.

To release the pressure the stud was pulled in an upward direction.

These studs loosened and allowed bleeding to recommence. The next development was the ring lying over the springlike forcep. When the ring was pushed down, the forceps locked—for a time. Another experiment existed about this time in the form of catch studs. To this day one may still find instruments in older hospitals—no longer used but, for some reason, preserved.

As we review these not wholly satisfactory instruments we may wonder at the progress of other surgeons who were not satisfied with the then existing artery forceps. When not using cautery or boiling oil, they resorted to other devices such as buttons of caustic. This, surely, was no less painful than the cautery but perhaps not so messy.

Baron Pierre—Francois Percy (1805) invented little lead rings which were squashed on the vessels by a pair of pliers. These same lead rings were the forerunner of the Cushing clips still sometimes used. About 1820 surgeons began to apply torsion to vessels. This procedure consisted of twisting the vessel several times until it occluded. This method also survives to this day. Bryan reports (Practice of Surgery 1879) "in Guys Hospital we have two hundred consecutive cases of amputation of the thigh, leg, arm and forearm, of which all the arteries have been twisted (one hundred and ten have been of the femoral artery) and no case of secondary haemorrhage". Torsion became very popular but not all surgeons were satisfied.

The next phase, or parallel phase, was the introduction of linear crushing. J.G.F. Maisonneuve (1809-1897) introduced an instrument which resembled the snares we use today. The wire-loop was passed around the vessel, pulled taut and the vessel was virtually "Strangled".

Chassaignac, another French surgeon, replaced the wire with a jointed chain. Chassaignac's chain was to last for 50 years. This instrument would excise a tongue as it was tightened one notch every hour.

Pean, and later Spencer Wells, were to record that artery forceps left on a patient for several days would eventually drop off of their own accord with no harmful effects to the patient.

Sir James Y. Simpson was an advocate of "accupressure". This consisted of placing a pin across the vessel as we pin the stem of a flower to our buttonhole. The obliterated vessel ceased to bleed and it was presumed that all was satisfactory (one wonders what happened to loose pins!), English surgeons claimed that pins were highly favoured in Scotland because they were cheaper than instruments. This claim is un-substantiated. We have now seen that the ideal instrument had not yet arrived while there was also much disagreement as to which was the best technique.

Joseph Frederick Charriere (1803-1876) became the first surgical instrument maker of repute. He was quickly followed by surgical instrument makers in the United Kingdom and the United States of America.

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In 1865 Lister introduced antiseptic techniques to surgery. The story of the establishment of Lister's theory could occupy many pages of this journal and it is regretted that the Lister story receives so little attention in this brief history of haemostats. However, as Lister proved that sterilisation and care made possible many surgical practises which were talked about and never performed, the demand for new instruments increased. Allied to these new interests was the gradual acceptance of anaesthetic agents; chloroform and ether. The use of anaesthetics gave surgeons more time to explore the possibilities, and practise the combination of these factors. Aseptic practise and anaesthesia brought instrument manufacturers together in a common fight. There were more instruments because there was more surgery. However the common enemy still remained—how to control bleeding. Spencer Wells gave much thought to the manufacture of the ideal artery forcep. Among his theories were the beliefs that artery forceps should be strong, with the joint in a position to exercise good leverage enabling the forceps to be forcibly compressed—"rotation used if for large vessels". The original Spencer Wells forcep had small bows, rigid arms and a one step rack which had been incorporated from a design made by the French instrument maker, Mathieu. The credit for the first crocodile jawed forcep also rests with Mathieu. Spencer Wells wrote articles in the British Medical Journal correcting the impression that Pean had been the first surgeon to use forci-pressure.

It is not clear who introduced the second rack on artery forceps but the reason for doing this was to increase the pressure of the jaws as and when required. For many years, the surgeons and instrument manufacturers varied the shape, length and general design of the forceps.

Eugene Doyen of Paris (1859-1916) improved the Spencer Wells forcep as he shortened the jaws to increase leverage. His forceps had teeth on the end and are generally known as Lanes. Some surgeons contested that toothed forceps lacerated the vessels so used non-toothed forceps.

It will be appreciated that surgical instruments were made in many parts of the world, all designed to meet the needs of the Surgeon who frequently worked in very close collaboration with the instrument makers to whom is owed so much. Typical of the changing pattern was the decision to abandon forceps specifically designed for torsion only. It was universally agreed that artery forceps would serve the same purpose. Artery forceps with crossed branches had taken many decades to arrive.

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Sir Charles Bell (1807) had designed the Bells tenaculum. This hooked instrument picked up vessels, allowing them to be ligatured immediately. Dieffenbach (1792-1847) had designed a catch forceps which, when applied to a vessel, arrested bleeding and freed the hands of many assistants who formerly held innumerable pairs of forceps which did not grip of their own accord.

Jules Pean (1830-1893) is credited with having designed the artery forceps in use today. His forceps were of the cross action type with a three step rack, the rack having been introduced by Charriere. Pean's pupils wrote in their notes that "when operating Pean never used ligatures or compresses but he sometimes left artery forceps on for several days".

The preceding may seem to be somewhat confusing but it is intended to show how there was no general agreement as to which was the best type of artery forcep. This is not really surprising because even to this day no two hospitals entirely agree as to what constitutes a "general instrument set".

We have seen that surgical procedures undreamed of during the 17th century were being introduced during the second half of the 18th century. We have established that surgical instrument manufacture had become a specialty and, in the main, artery forceps had remained comparatively short in length.

Lane and other surgeons agreed that the then standard of dipping unsterile hands and short instruments into abdominal or other wounds was of no service to bone surgery. As a result of this thinking the "non-touch" technique came into being. Lane enforced his principals and caused his artery forceps to be lengthened to keep his hands out of the wounds.

The same principles were applied to bone forceps and other instruments.

Halsted, a young American surgeon, introduced india-rubber gloves in 1890. It is said that he originally developed these gloves to protect his (future) wife's hands from becoming roughened by the use of antiseptics. The idea that sterile gloves should be worn during surgery won many adherents. At the same time this meant that the bows of the instruments had to be larger to allow glove thickened fingers to grip the instrument. With further advances in surgical techniques, instruments began to take on curves and bends. Artery forceps which carried the ligature down to a vessel evolved through many stages and as we know are used by Surgeons today.

We are indebted to Harvey Cushing, Crile and Halsted for the introduction of mosquito forceps. These gentlemen formed part of what was known as "The Dainty School". All shared the belief that the body resented every injury, no matter how trivial. Harvey Cushing established fame for his work in brain surgery, at one stage reporting that he had rejected 70% of patients who came for operation, but on accepting them during the following year reported that all recovered following operation. We must assume that, along with other factors, suitable instruments were not available during the year of rejection.

The gradual improvement in the design of the jaws of artery forceps must be credited to the many surgeons who have discussed their problems and shared their experiences. By the 1930's diathermy had entered the field and artery forceps had turned a full circle. Electro-surgical intervention owes much to d'Arsonvall of the College of France, who in 1890 demonstrated the effects of electrical stimulus to human muscle. It is known that severe muscle contraction occurs when the body is brought into contact with ordinary mains

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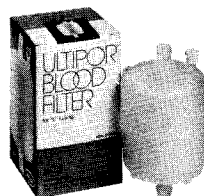
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current. Currents of relatively low strength can cause death from electric shock due to violent muscle reaction produced by the stimulus. d'Arsonvalls demonstrated that muscle contraction decreased as the frequency of the current increased until at about 10,000 cycles per second the effect was no longer evident. He also demonstrated, as he passed currents through his own body, that electricity will flow through the body without ill effect. He demonstrated this phenomenon by lighting an electric lamp via high frequency current through his own body. This experiment would prove lethal were we to try it with alternating currents of 50 or 60 cycles per second. High frequency current used in surgical diathermy may be as high as 3.5 million cycles per second—well beyond the response of muscle nerve fibre to electrical stimulation.

During the use of diathermy the patient becomes part of the circuit, as in d'Arsonvalls experiment. Current passes effortlessly over the tungsten wire of the diathermy electrode and, as the electrode touches the artery forcep, continues down the instrument to seal the capillary vessels and coagulate at the same time. As we have seen, the current may also be passed down the ordinary dissecting forceps which bear an insulating sleeve.

So ends this brief history of haemostats. As we care and handle the instruments of today it is worth remembering that the many brains of eminent Surgeons and Physicians have made these instruments possible today.

This article cannot be concluded without adding our appreciation of the skill, patience and knowledge of the instrument manufacturers and technicians without whom the surgeon might still be using the carpenters pliers.

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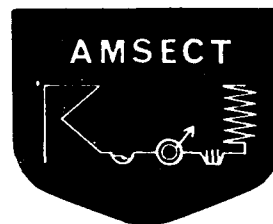
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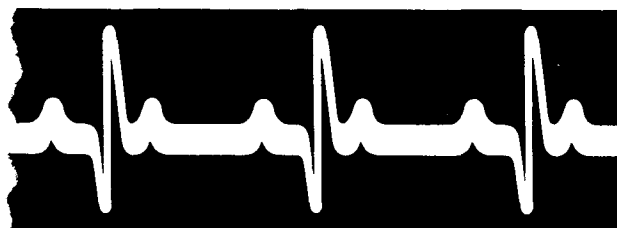
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