Ambroise Paré II: Paré's contributions to amputation and ligature

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Surgical amputations date back to Hippocrates and were for many years one of the main functions of the surgeon. Limb injuries were the most common anatomical injury encountered in conflict. Limbs were amputated most frequently because of war injuries or accidents. One of the major problems associated with amputation is the loss of blood. There are very few references to amputation as a treatment prior to the invention of gunpowder; however, the widespread introduction of firearms in conventional warfare throughout 16th century Europe changed the nature of battlefield injuries from penetrating stab wounds and blunt injuries of earlier centuries to extensive soft tissue damage and comminuted fractures, coupled with contamination from embedded missiles and clothing. These frequently resulted in gangrene and death and so amputation was the only effective treatment. Ambroise Paré (1510–1590) was one of the first military surgeons to encourage primary amputation for the treatment for gunshot wounds; he was

also one of the first to choose an amputation site well above the gangrenous area.

During the 16th century the decision to amputate was influenced more by religious belief than by the nature of the injury, as death from a limb wound was often more readily accepted than elective mutilation of the human body. When amputation did occur it was reserved for gangrenous extremities and was performed through dead tissues to avoid blood loss. Infection following gunshot would rarely resolve until all sequestra and debris were removed; in such cases secondary amputation was the only potentially curative option. It was also common to use fire after amputations of the limbs, in order to consume and check the putrefaction which is common to gangrene and mortification. Although cauterisation was also used to stem haemorrhage it also destroyed flaps of skin needed to cover the amputation site, increasing the risk of infection. Amputation was therefore often complicated by infection and haemorrhage and many patients died.

French military surgeon Ambroise Paré, although not the first to advocate the ligature, is responsible for introducing it in favour of cauterisation. He rediscovered the use of ligatures, using a thread-like or wire material to constrict a

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patient's blood vessels. This surgical technique, which stops the flow of blood from a severed artery and vein, greatly reduced the patient's chances of losing too much blood.

During the first period Paré stopped using cauterisation, which was done at that time with boiling oil. All the authorities on gunshot wounds had taught that they were poisoned, envenomed by the powder, and that in order to counteract the poison they should be treated with burning oil. On his very first campaign Paré made the great discovery that boiling oil was not only of no use, but actually hurtful in gunshot wounds. The French troops, after a bloody fight, had captured the castle of Villaine. Paré dressed the wounded in the accepted fashion with boiling oil, stating that he had read in John of Vigo that gunshot wounds were venomous because of the powder and must be cauterised with boiling oil to destroy the poison. But, owing to the great number to be dressed, “at length my oil lacked and I was constrained to apply in its place a digestive made of yolks of eggs, oil of roses and turpentine. That night I could not sleep at my ease, fearing that by lack of cauterisation I would find the wounded upon which I had not used the said oil dead from the poison. I raised myself very early to visit them, when beyond my hope I found those to whom I had applied the digestive medicament feeling but little pain, their wounds neither swollen nor inflamed, and having slept through the night. The others to whom I had applied the boiling oil were feverish, with much pain and swelling about

their wounds. Then I determined never again to burn thus so cruelly the poor wounded by arquebuses (portable long-barrelled guns).”

During the second period, in his “Dix Livres de La Chirurgie” 1564, Paré first published his method of ligating the vessels in amputations, stating candidly that in doing so he entirely ignored the method of stopping bleeding by cauterisation which he had recommended in his book, published in 1552. Paré’s account of his experiences at the siege of Metz in 1552 is one of the most graphic of his revelations. The Emperor Charles V laid siege to Metz in the late autumn of 1552. The Duc de Guise, d’Enghien, Conde, and many other nobles were in the city and determined to hold out to all extremities. There was great mortality among the wounded in the town and Guise sent word to the King requesting him to send Ambroise Paré with a fresh supply of drugs for him as he feared those they had were poisoned. Paré states that he does not believe the drugs were poisoned but that the wounded died because of the severity of their wounds and the extreme cold

of the weather. The King arranged to have Paré smuggled through the enemies' lines by an Italian captain who received 1,500 écus for conveying him. Paré arrived within the walls of Metz at midnight. He was taken to the bedside of the Due de Guise who greeted him warmly. The very next morning Paré set to work. After he had brought the greetings of the King to the various nobles and gentlemen who were so bravely defending the city and had distributed his load of drugs to the surgeons and apothecaries, he fell to dressing the wounded who kept sending for him from all quarters. He set one seigneur's leg, which had been broken by a cannon shot. Paré amputated an officer's leg by his new method, using the ligature instead of hot irons to check the haemorrhage. "I dressed him and God healed him." He returned home gaily with a wooden leg, saying that he had got off cheaply without being miserably burned to staunch the bleeding.

In 1585 Paré published the fourth collected edition of his works, the last to appear in his lifetime, containing the invaluable addition of his "Apology and Journeys." The latter book was written because of an attack made on Paré by Etienne Gourmelen in his book on surgery. Gourmelen especially attacked Paré for his use of the ligature in amputations. The case of his brother-in-law, Gaspard Martin, master barber–surgeon of Paris, who had died after Paré had amputated his leg, was cited as an instance of the failure of the ligature. The discussion between and Ambroise Paré gives an indication that the ligature of vessels was not so easy to accept.

Etienne Gourmelen writing to Ambroise Paré: "Badly then and too arrogantly, indiscreetly, and temerarily, a certain personage has wished to condemn and blame the cauterisation of the vessels after the amputation of a corrupt and rotten member, much praised and recommended by the ancients, and always approved, wishing and desiring to show and teach us, without reason, judgment or experience, a new way of tying the vessels, against the opinion of all the ancient physicians, giving no caution nor advice that there frequently happen many more great perils and accidents from this new fashion of tying the vessels (which he wishes to be done by a needle piercing profoundly the healthy part) than by burning and combustion of the said vessel. Because, if with the needle one should prick some nervous part, to wit even the nerve itself, when he wishes by this new and untried means, grossly to constrain the vein in tying it, necessarily there will follow a new inflammation, from the inflammation a convulsion, from the convulsion, death: for fear of which accidents Galen never dared to stitch transverse wounds (that which is always less dangerous) before uncovering the aponevroses of the muscles. Moreover, this the forceps with which, after the section, he once more tears the flesh, while he thinks it possible to draw forth the vessels which are drawn back towards their origin, brings no less pain than the hot iron. And if anyone having experienced this new fashion of cruelty, has recovered from it, he should render thanks to God forever, by the goodness of whom he has escaped such cruelty, feeling rather his executioner than his methodical chirurgien."

Ambroise Paré writing to Etienne Gourmelen: As to authorities I will come to that of that grand man Hippocrates, who wills and commands the recovery of fistulas of the fundament by ligature, as much to absorb the callosity as to avoid haemorrhage. Galen, in his "Method," speaking of a flow of blood made by an external cause, of whom see here the words: It is most sure to tie the root of the vessel, which I understand to be that (part) which is most near to the liver or to the heart. Avicenna commands to tie the vein and the

artery, after having uncovered it towards its origin. Gui de Chauliac, speaking of wounds of the veins and arteries, enjoins the surgeon to make the ligature on the vessel. Monsieur Hollier in Book III, chapter 5, of his “*Matiere du Chirurgie*,” speaking of the flow of blood, commands expressly to tie the vessels. Bec de Corbin Calmetheus, in his chapter on the “*Wounds of Veins and Arteries*,” treats of a very sure means of arresting the flow of blood by ligature of the vessels. Celsus, from whom the said physician hath taken the greater part of his book, recommends expressly tying the vessels in the flow of blood following wounds as a very easy and very sure remedy. Vesalius, in his “*Surgery*,” directs that the vessels be tied in a flow of blood. Jean de Vigo, treating of haemorrhage from recent wounds, commands to tie the vein and artery. Tagault, treating of the means of arresting a flow of blood, commands to pinch the vein or artery with a crow beak, or a parrot beak (This instrument was illustrated in the first article), then to tie it with a strong enough thread. Pierre de Argellata of Boulogne, discoursing of flow of blood

and the manner of arresting it, gives a fourth means expressly, which is done by ligature of the vessels. John Andreas a Cruce, a Venetian, makes mention of a method of arresting the flow of blood by ligature of the vessels. D’Alechamp commands to tie the veins and arteries. As to that which is necessary (say you), “to use fire after amputations of the members, in order to consume and check the putrefaction which is common to gangrenes and mortifications,” that in truth has no place here because the practice is to amputate always the part above that [portion] which is mortified and corrupted, as wrote and commanded Celsus, to perform the amputation on that which is healthy, rather than to leave any of the putrefied. I would willingly demand of you, if when a vein is cut transversely and has retracted itself very much towards its origin, you would not scruple to burn until you had found the orifice of the vein or artery, and if it is not more easy with only a crow beak to seize and draw forth the vessel and tie it? In which you show openly your ignorance, and that you have your mind possessed with a great animosity and anger.