MANLEY (T. H.)

# SOME OF THE USES

OF THE

# TEMPORARY-TRANSFIXION LIGATURE.

BY

THOMAS H. MANLEY, M. D.,

OF NEW YORK COUNTY.



[*Reprinted from Vol. VI of the Transactions of the New York Medical Association.*]

Concord, N. H.

REPUBLICAN PRESS ASSOCIATION, 22 NORTH MAIN STREET.

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Dear Dr. Granger.

I send to you today an abstract of an article in reprint, and as it cost considerable labor, in the reprint, I would consider it a favor, if you would give it a brief comment, in your column of reviews, when convenient.

And oblige, Yours Resp.t.

Thomas H. Manley.

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# SOME OF THE USES OF THE TEMPORARY-TRANSFIXION LIGATURE.

In the whole realm of surgery there is nothing more appalling than the presence of alarming haemorrhage. As a subject of study, haemorrhage ranks in importance second only to the antiseptic treatment of wounds. But, strange to say, while the technique of operating and treating wounds has undergone much important modification and improvement, the management of haemorrhage has not kept pace with these advances in the surgical art; and with the exception of the Esmarch bandage and the clamp forceps, little progress has been recently made in this direction.

In 1870, Sir James Paget, speaking of what had been accomplished up to that time, and of what might be accomplished in the future, in the treatment of aneurism, said,—"In our own time progress has made such rapid advances that the mortality, which, under the system praised by Mr. Hodgson, must have amounted to a large percentage of those operated on, is now very much reduced by the invention of instrumental compression; and even this will no doubt soon be further reduced by the more frequent use of flexion and digital pressure." Continuing, he said,—"A century hence, we may hope, our descendants will have as valid a reason to boast of improvements upon the science of Watson and Latham, as we have to congratulate ourselves on our advances upon the doctrines of Pott, Larry, or Crampton."

Little did this distinguished author and surgeon imagine that, at the very time he was making this prophetic forecast in London, Lister, in Edinburgh, was conducting a series of experiments which have since revolutionised the surgery of the whole civilised world, and in no particular more manifestly and salutarily than in the control of haemorrhage.

The elastic bandage was at that time in use in Germany, and the problem of dealing with bleeding in the extremities was solved; but the question of devising a plan for the more effectual preventing or controlling haemorrhage in other regions of the body was yet unsettled.

Since the dawn, however, of antiseptic surgery, and the present advancement of our knowledge of the histology, physiology, and pathology of the blood-vessels, surgeons perform successfully operations which, within the recollection of us all, would have been regarded as reckless mutilations, and condemned as almost never justifiable.

With the fear of infection banished from his mind, and with a good knowledge of practical anatomy, the ingenious and intrepid surgeon of to-day hesitates not, when conditions require it, to open into almost any part of the body. A similar freedom of fear of haemorrhage would greatly enlarge the field of justifiable operation. But before describing the temporary transfixion-ligature, which has proved of value for this purpose, it seems desirable briefly to review the methods now in use for the arrest or control of haemorrhage.

Pressure, as a ready means of stopping haemorrhage, is very ancient. Dr. Hodgson tells us that the Greek and Arabian physicians, more especially Ætius, Paulus of Ægina, distinctly and emphatically recommended the application of the ligature on the vessel for the stoppage of blood in wounds and aneurisms, many centuries before the time of Paré, Hunter, or Anel. The same author also tells us, from the most authentic sources, that though Ambrose Paré applied the ligature on the bleeding artery in 1550, it was practised long before that time, but had fallen into desuetude, until its application was revived and extended by that distinguished surgeon. He further states, referring to John Hunter, that though he was the first in modern times to successfully treat aneurism by the deligation of the artery, it had been done frequently by the great Grecian physician Praxagoras, and others, long before the Christian era.

It appears that in the time of the early anatomists it was

considered immaterial whether or not a vein was included within the ligature, their only care being not to include other tissues than the vessels; and it seems quite clear from the writings of Paré that he never thought of dividing the serous coat of the vessel with the ligature. He only insisted that great care must be observed in drawing the knot not to strangle a large nerve-filament, as he taught that this mishap, by reflex irritation, would cause tetanus, or a most painful spasm of the muscles.

Hunter, in his original operation for closing the popliteal artery, tied that vessel in the groove of the adductor longus muscle, where the vessel curves behind the knee. He always used thin tapes, and never less than three with two or three in reserve, thrown over the vessel above and below the point of ligation.

Scarpa, more fully realising the object in view, and having a wider comprehension of the physiology of the circulation, secured the vessel with one ligature only, at a point near its emergence from the abdomen, just below the origin of the profunda.

Acupressure—the transfixing of tissues, including the vessel, with a pin—has sometimes been employed in the past, and even to-day is successfully used for closing the superficial veins of the extremities and the vessels of the scalp. It, however, never came into general use, owing to the danger of infecting deep tissues, producing erysipelas, purulent inflammation, or gangrene. These possible accidents more than counterbalance the occasional good realised from its employment.

Many and varied have been the methods adopted for moderating or temporarily shutting off the arterial current,—postural pressure produced by flexing the limb, digital and instrumental pressure, and latterly pressure *en masse* by Esmarch's bandage.

The appliance most generally used until lately for closing the lumen of a large arterial trunk was the tourniquet. Like the elastic bandage, it answers well for the distal portions

of the extremities, where the vessels pass over bony ridges, and can be compressed; but in other situations it is of little avail.

Digital pressure acts on the same principle, but is not so apt to injure surrounding parts, and is intermittent. It has been very often, and successfully, employed by the Dublin surgeons, who first called the attention of the profession to its efficacy as a preliminary and precautionary proceeding for producing full dilatation of all the anastomotic vessels of a limb, prior to closing the main artery with the ligature.

It is now something more than twenty years since von Esmarch gave us the elastic bandage. Its generally successful use completely upset the theories and notions of physiologists and surgeons at that time. Esmarch, totally disregarding the warnings and teachings of that period, with reference to the vessels which would not bear compression, etc., commenced at the extremity of a limb with his rubber ligature,—for such it really is,—and, including all the tissues within its rigid embrace, squeezed out the contents of every vessel, and completely stopped the circulation as he moved the constricting band towards the trunk.

Next to the antiseptic treatment of wounds, this modern plan for the control of haemorrhage has been foremost in revolutionising the technique of operations and saving human life. Its successful application has demonstrated that the vascular system will bear with remarkable impunity a vast amount of bruising, laceration, and stretching without its vitality or integrity being seriously impaired.

That the tissues must be fairly healthy, and the vessels free from atheromatous or organic changes, to endure with safety the firm, harsh grip of the rubber bandage for many consecutive hours, needs no proofs. When we bear in mind the agonizing pain which the conscious individual suffers when the rubber is applied, it can hardly be questioned that its use must not infrequently be followed, sooner or later, by serious disorganisation of the tissues within its tight embrace.

There are many situations in which the elastic bandage is

wholly inapplicable. It can be of no service in amputations at the hip or shoulder-joints, in the regions of the great cavities, or in wounds or operations about the face or neck. It should, in order to do the least harm, be applied by an experienced hand. It is more apt than the tourniquet to be followed by secondary haemorrhage. The bandage being composed of rubber quickly deteriorates, and this is a very serious objection where its use is only occasional. Another objection to it is, that while applied it cuts off every kind of circulation beyond the point of constriction, and for the time every source of nutrition for the tissues. There is a chance, also, that the smaller vessels and capillaries may be so plugged with thrombi that perfect circulation in them never becomes completely reëstablished.

Next to pressure upon the vessels, a plugging of them by the coagulation of the blood is the most common and effective process in arresting haemorrhage. Though it has been demonstrated by distinguished investigators that coagulation plays but a subordinate part in the immediate closure of a vessel of large size, when the ligature is applied, still as one of nature's haemostatics it occupies a position of paramount importance. In capillary bleeding, venous oozing, and in slight wounds of the smaller arteries, this spontaneous solidification or thickening of the blood itself will prevent its farther escape. We are occasionally apprised of the great danger to life which a trivial wound may be in one whose blood is wanting in this property.

The real chemical or vital processes involved in the coagulation of the blood are but very imperfectly, if at all, understood by physiologists. The physical and chemical processes connected with it, when occurring outside of the vessels, have been explained, along with certain conditions which modify it; but the questions of the cause of this phenomenon, —how the coagulation is effected in the living vessel, and what the changes in the circulating fluid which occasion it are,—remain unanswered.

How long does it take a coagulum sufficiently firm to be

a permanent barrier to the blood current to form, after the healthy vessel is constricted in its continuity by pressure or deligation? It is indispensable that this question be most carefully considered before deciding on the merits of the transfixion-ligature, and I shall recur to it presently, when giving the results of some experiments on animals to determine the effects of temporary ligation of the vessels.

The first occasion on which I had recourse to the transfixion-ligature to arrest haemorrhage was in the treatment of the following case:

Last winter a young woman applied at the Harlem hospital to be operated on for the removal of several large strumous glands, which occupied a large area below the ear and angle of the jaw, on the right side of the neck.

After making a long, free incision on a line with the mastoid muscle, the capsule of the most superficial gland was reached. There was no trouble until the last and most deeply seated gland was reached. Its outer or convex surface was easily denuded and freed, but its base and borders were bound down by tough, old adhesions of a leathery consistence. By keeping close to the gland, however, and tearing away rather than cutting the adhesions from above and laterally, it was almost entirely liberated, a small portion only of the base remaining. This was being teased, and lifted out partly with the aid of the dressing-forceps in tearing and detaching, and the scissors in snipping; and it seemed all but cleared when there was a sudden gush of blood. It came with such force, suddenness, and volume that in an instant it seemed to cover everything. The wound was quickly packed, and pressure exerted, but still the blood came filtering through the meshes of the gauze as through a sieve. The patient's features became deathly pale, her eyes began to roll and the facial muscles to twitch. An assistant pressed firmly upwards against the cervical vertebrae, and I removed the gauze and clamped up everything that I could seize, for no leaking vessel could be seen; but it was of no avail, the blood came pouring out, and it seemed that in a few minutes all would be over.

Crowding the packing down again temporarily to stay the tide, a thought came to my mind, and, seizing a needle-holder which lay near by, armed with a long, rather sharply-bowed needle and strong silk ligature, I passed the point of the needle deeply into the tissues, above the point of incision, on a line with the thyro-hyoid membrane, and carried the point sufficiently low to pass under and around the great vessels of the neck—arteries and veins; then making a sharp turn I brought the point out through the middle of the sheath of the mastoid muscle, and

quickly tied the ligature, constricting the whole included mass. The effect of this procedure was instantaneous; the haemorrhage was controlled. It was clear, from the congested state of the veins of the face, and the total absence of pulsation in the temporal artery, that the ligature had passed under and embraced both the internal jugular vein and the common carotid artery.

The remaining portion of the tumor was now detached, the wound well irrigated, and the line of incision closed with the continued catgut suture. The young woman rallied well. The day after the operation the knot on the transfixion-ligature was opened, when everything was found doing well. I took the precaution of using the slip-knot, with long, loose ends, so that if haemorrhage should recommence on its release, it could be easily tightened without disturbing the tissues.

At the third dressing, about forty hours after the operation, the silk was withdrawn; and the patient was dismissed, with the wound firmly healed, on the tenth day.

It was most gratifying to me to hit on any sort of contrivance to promptly arrest haemorrhage in an operation where many well known and skilful surgeons have seen their patients bleed to death without being able to save them.

The elder Gross, Dr. Wyeth, and Dr. Briggs, of our own country, with Cooper, Valpeau, and Langenbach, of Europe, all report cases in their own practice which succumbed to haemorrhage occasioned in removing tubercular masses from the neck.

In view of the success of this first trial, it occurred to me that, in conjunction with the modern antiseptic methods, the temporary-transfixion ligature might find a wide application. A fair estimate of its value and its range of application, however, could not be made without a series of investigations and dissections on the cadaver, for the purpose of studying the topographical anatomy of those regions in which transfixion by ligature seemed expedient. After applying the ligature over various vessels, I dissected down on it, closely observing the different tissues pierced or mutilated in the passage of the needle.

I commenced, in December, 1888, a series of such dissections on the human body, beginning with the arteries of the lower extremities.

I applied the ligature with ease to the posterior tibial artery, where it curves behind the internal malleolus. In cutting down upon the ligature, I found it embraced, among other structures, the posterior tibial nerve and the tendon of the flexor longus pollicis. Inserting the needle again under the anterior tibial or dorsalis pedis artery, to the inner side of the extensor muscle of the great toe, just below where the vessel emerges from under the anterior annular ligament of the ankle, I brought out the point within an inch of where it entered. Dissecting down, it was discovered that the ligature had penetrated the anterior tibial nerve, and one of the venae comites, besides the tendon of the extensor longus digitorum. I next essayed the inclusion of this vessel just below the insertion of the quadriceps tendon (ligamentum patellae), when I at once saw that in order to bring the steel pilot under the vessel I must carry its point down close to the surface of the bone. On dissection, I found that the needle went safely under the artery, and came out without touching the nerve; but owing to the deep situation of the vessel here, I had to employ a longer needle, and include considerable muscular tissue.

My next venture was with the popliteal artery. This vessel, with the large number of branches which it gives off in the popliteal space, the large terminals of the sciatic nerve, the confluence of the popliteal and tibial veins and the venae comites, and the narrow, shallow form of the space, all conspired to make the successful application of the ligature very difficult, and liable to injure important structures.

I selected a long, slightly curved needle, firmly secured in a needle-holder, and sent it about an inch downwards, until the bony surface of the femur was felt. I then made a sharp, curvilinear movement, carrying the needle's point on the external aspect of the limb. The needle entered very near the apex of the space where the fleshy substance of the hamstring muscles begins to taper into tendon. On dissection, along with other structures, the popliteal artery, vein, and nerve were found within the silk. A few small veins and articulating branches of the artery had been lacerated by the needle in its transit. A few fasciculi of the outer head of the gastrocnemii, with portions of adjacent tissues, had been punctured, the needle emerging through the tendons of the biceps and vastus externus muscles.

Scarpa's triangle was next sought, and efforts made for the ligation of the femoral artery. This time, in trying to secure the vessel without taking up too much muscular tissue, I passed the needle through the femoral vein. With a longer and more sharply curved needle, and by first forcibly adducting the limb, on the second trial I succeeded in getting under both vein and artery. The vein is very deeply lodged above the hiatus in the fascia lata, but where it lies on the ridge of the os pubis it is more superficial. Immediately below this point the vessels are readily ligatured in spare individuals.

I have tested the efficacy of the ligature in castration. I take up the spermatic cord, feeling for and separating the vas deferens, then pass the needle and silk through, and tie everything firmly. When applied, it permits no retraction of the cord till all the vessels are separately and securely tied and the operation completed.

Having demonstrated on the cadaver the possibility of applying the ligature to most of the larger arterial trunks of the extremities, without apparent serious injury to the structures invaded, I extended my experiments to the neck. I fully appreciated the magnitude of the issues involved here in the event of accident, though it was undoubtedly with the deep, internal jugular that I had to deal when the transfixion-ligature was first successfully applied.

In critically considering the circulation in this situation, we are at once impressed with the number and size of the vessels, and their complex and intimate relations to vital structures. Between and closely connected with the numerous vessels in the neck are the cranial, cervical, and sympathetic nerves. After arming the needle-holder with a rather long needle, well bowed, I seized the larnyx with the left hand and pressed it toward the right. The point of the needle was sent directly downward, following closely the border of the thyroid cartilage, till I felt assured it was on the floor of the space occupied by the internal jugular vein, on the anterior surface of the rectus capitis anticus major muscle, when the needle was made to describe a sharp curve. the point coming out through the integument two and one half inches from where it entered.

On dissection, the ligature was found to include the following structures : The skin, the platysma and the posterior, or concave border of the omo-hyoid muscles, the ascending pharyngeal artery, the rectus capitis anticus major for about one third of its thickness, the scalenus anticus and a few fibres of the sterno-mastoid muscles, the vagus, spinal accessory, and part of the sheath of the second cervical nerves, the common carotid artery and internal jugular vein lying near the central part of this constricted mass. I repeated this experiment on both sides of the neck in three different subjects, with substantially the same results.

It was evident to me, from these experiments, that the application of the ligature in spare built subjects just below the bifurcation of the carotid was not very difficult or dangerous, though as the vein usually lies farther away from the artery as it approaches the sternum, the application of the ligature low down in the neck might be attended with danger. Though its use must always involve more or less risk when we approach the angle of the jaw, yet in an emergency attended with immediate danger to life from haemorrhage, and without other appliances within reach, I would not hesitate a moment in adopting the method under consideration.

As I had applied the ligature during the past winter to the facial, temporal and coronary arteries, with their branches, on the living subject, I had no need to do experimental work on that part of the cadaver. It now remained to deal with the upper extremity.

I began in the axilla with a view of taking up the brachial artery as it passes over the border of the latissimus dorsi muscle at its humeral insertion. Here the procedure was much simplified and more easily executed by raising the arm to a line parallel with the axis of the body, and slightly rotating the shoulder outwards. After a careful survey of the landmarks and the relation of the vessels, I fixed a medium sized bowed needle in the needle-holder, the shaft of the needle being held at right angles to the handle, and passed the needle's point from within outwards, close to the outer margin of the insertion of the pectoralis major and the inner border of the biceps, keeping close to the shaft of the bone till I felt assured that the needle had passed under the vessels, when a quick, arching motion was made, and the needle brought out three inches internal to the point of introduction.

On dissection, I was gratified to find that in carrying the silk around the large vascular trunks, no important parts had been lacerated. The ulnar nerve alone had been partly torn on its under surface. On other subjects I was not so fortunate. In one instance I transfixed the median nerve, and in another pierced the cephalic vein.

The brachial artery, where it slips under the bicipital fascia was next ligated. In this situation the ligature of the vessel is a very simple matter. The basilic vein and the integuments can be drawn slightly to one side, the needle entering close to the inner border of the vein till the osseous surface is felt, then brought out by the same quick, circular movement of the hand. My first transfixion at the elbow was attended with laceration of the median nerve. In my second and subsequent efforts, by introducing the needle a little further from the vessel, the nerve escaped injury.

From my experiments, I am convinced that the ligature may be safely and easily applied to any healthy vessel, wherever situated.

The next step in the experimental study of the effects of temporary ligation of the vessels was to determine the length of time a vessel might be obstructed without causing a coagulation of blood within it or its branches, and the injurious effect of such transitory pressure upon the nerves. For this purpose experiments were made on living animals.

A medium sized dog was etherised, and the ligature carried through the tissues, close to the windpipe, around the vessels, and then tied. Blood oozed freely along the ligature for a minute or two, and then

ceased. Immediately there was well marked congestion of the conjunctiva on that side, and the tissues lining the mouth were also deeply congested. The carotid ceased to beat above the point of ligation. The animal was allowed to come out of ether, and four hours later was examined. Although the ligature completely arrested the circulation in the artery, it was apparent that the collateral vessels had reëstablished a current, for the congestion had passed off; and except for some slight uneasiness which the silk caused the animal, there was nothing unusual about his appearance. The ligature was then cut and withdrawn, the artery above the constriction immediately filling. The dog ran about the next day in his usual health. I repeated the same operation on the same dog on the other side a few days later, with the same results.

After he had recovered from these experiments, I first compressed and then divided the vagus nerve in the carotid sheath. I did this to estimate the effects of nerve-injury which might possibly be inflicted by the transfixion method. Immediately on section of the nerve the heart was thrown into the most tumultuous action, and the respirations were more than tripled in frequency for a few minutes; but equilibrium was restored within half an hour, and a day or two later the dog was as well as ever.

In the dog, the ligation of the femoral and brachial arteries by the transfixion-ligature is very easy, there being so little fat that they are easily reached. I have left the ligature on four, seven, and twelve hours, and in every case, on freeing the vessel and removing the ligature, the distal portions of the arteries at once filled with blood.

There can be no doubt, in these experiments on the dog, that the veins were occasionally wounded; but they quickly closed, and there was no evidence of injury to the nerves from long and continued pressure, as neither sensation nor motion was in the slightest degree impaired, as far as could be observed.

Though in the dog the circulation is not so rapid nor the blood so coagulable as in the human being, yet a fair estimate can be made from these experiments as to the range of usefulness and safety of the ligature. Without the very modern discovery by Lister, it would be wholly inapplicable as an agent for the control of bleeding, and would be always fraught with danger.

It was only quite recently, also, that it was proven that the healthy vein is not so liable to take on inflammation from a slight trauma as was formerly supposed; and it was left for von Esmarch to demonstrate to the profession the vast

amount of long and severe tension which the veins can safely sustain. The successful use of the hypodermic needle, which antedated the application of antiseptic principles, also demonstrates the impunity with which tissues may be injured without lasting ill effects.

In taking up deep trunks or vessels under thick layers of fat, one must have a reliable needle-holder, although in easier cases a simple needle and thread will suffice. It is of the greatest importance that the ligature be rendered thoroughly antiseptic, and the parts to be pierced be entirely aseptic. Silk thread should always be preferred, if circumstances permit a choice. Being applied only as a temporary expedient, its strength and non-liability to slip or stretch give it advantages over other ligatures. Silver wire tears and corrodes. Catgut, when used in my experiments, relaxed after two or three hours to such an extent as to permit the circulation to become partly reëstablished.

A most important part of the apparatus is the needle. It should be made of well tempered steel, spear-pointed, and bowed according to the special region to be explored,—the deep vessels requiring a long, obtusely bent needle, and the superficial ones a short needle with a rather sharp angle. The shape and length of the needle are of infinite moment, but experience alone can guide the choice in each particular case.

The needle-holder makes the insertion of the needle much easier than when the naked finger and thumb are used, but caution must be exercised, as the tactile sense is less acute.

The operator must, of course, have a good and practical knowledge of anatomy, for he must mentally and clearly outline the course of the vessels to be compressed, and their relations with adjacent parts. The needle is passed in on as near a vertical line as possible, and sent down perpendicularly until it is reasonably certain that the level of the vessel is passed, when the heel of the needle is quickly made to describe a segment of a circle at as sharp an angle as possible, in order that the needle's point may reach the surface again,

embracing as little of the tissues as possible. The venae comites must always be included with the artery.

As an arterial vessel of large size is very movable, and rolls about under any sudden disturbance of the tissues, it is important to fix it with the finger of one hand while the other is performing these manipulations.

In applying the ligature to the femoral or brachial artery near the joints, the limb must be well rotated outwards and adducted. This movement brings the vessels nearer the surface, and insures their ready ligation.

When I first employed the ligature, I secured it with a sliding knot, and released it when necessary by drawing on the free ends, but I found the projecting ends in the way. If it appears, when the needle is introduced, that a vein of considerable size has been punctured, I withdraw and reintroduce the needle further down, taking care the second time to go deeper, and include more tissue.

As illustrations of the use of the temporary transfixion-ligature, I cite the following cases:

On the 20th of May, 1889, for the first time I temporarily transfixed the tissues for occlusion of the femoral artery, in an amputation at the hip joint. The patient was a rather fleshy female. Owing to the immense thickness of fat over the line of the vessel, its pulsations were very indistinct, and I was loath to transfix *en masse* through so much adipose tissue. Accordingly I modified my plan somewhat, as we must in all operations under peculiar circumstances. After commencing the oval flaps, I dissected them back for an inch or two. The arterial pulsation could then be plainly seen, as the vessel was quite superficial.

At this stage the needle was introduced close to Poupart's ligament and the point carried down close to the bone. The ligature was composed of heavy, braided silk, doubled. The needle was now, after its emergence, cut free from the ligature, and everything within the latter slowly but firmly compressed till the femoral pulse ceased. A reef knot was then tied, the free ends of the ligature snipped off, and the amputation proceeded with. On its division, the femoral artery was found empty of blood, and there was no haemorrhage except some slight spurting in the gluteal region.

The operation was almost bloodless. I was not encumbered or annoyed by the use of any kind of tourniquet or elastic bandage, which, at best, are more or less in the way, and always liable to slip; nor was the

attendance of a reliable assistant necessary to compress the vessel. The blood-supply was completely under control, as I could at any moment remove the pressure on the blood-vessel.

After the limb was disjointed and severed, the gaping, open mouth of the artery was closed, the ligature being applied to its denuded external coat with sufficient tightness to divide its serous tunic, and when it appeared that all haemorrhage was controlled, immediately before closing the flaps the temporary ligature was cut.

It was interesting at this time to see with what alacrity the lumen of the vessel filled, and feel the rebound with the bare finger as the circulating fluid came against the end of the vessel.

The patient's recovery was uneventful. The wound healed kindly, and she left the hospital six weeks later with a shapely and comfortable stump.

A male patient entered the hospital in April, with an epithelioma of the lower lip. The removal of those growths, as all know, is quite a simple operation, when only a limited area of tissue is involved, though any cutting through this spongy, vascular mass is often attended with loss of blood, which can be badly spared if the patient be anaemic. Much haemorrhage, also, interferes with the surgeon's movements, and intelligent assistants are needed to restrain it. We are warned by distinguished authors that when doing an operation for the excision of those cancerous ulcers, we must be cautious not to too deeply anaesthetise, as the blood which flows into the mouth may either occasion suffocation, or set up bronchitis by entering the bronchi if the sensibility of the glottis be blunted.

In our case, we first injected subcutaneously about the growth twenty-five drops of a four per cent. cocaine solution, when our patient walked into the operating-room and sat in a chair. The tissues now being well anaesthetised, a needle with double ligature was passed through the lower lip, close to the angle, half an inch below its vermilion border, from within outwards, and firmly tied. The same was done on the opposite side. With the patient sitting up, looking on, an orderly steadying the head, I leisurely cut away the diseased mass. There was not a drachm of blood lost, as none came from any source except the smaller veins and capillaries.

The divided tissues were brought together in the usual way, and then the temporary ligatures were cut and withdrawn. It is clear that with this means for the control of haemorrhage the practitioner can do this operation alone. For instruments he needs only a good scapel, with a needle and a little silk.

A police officer cut his wrist severely with glass from a broken window, which he had smashed while drunk. Both the ulnar and radial arteries, with several of the tendons of the wrist, were divided, and the vessels were bleeding copiously.

I had an Esmarch bandage with me, and though there were several people in the room they were so sickened and horrified at the presence of so much blood that no one could give me the slightest aid. Under the circumstances, it was altogether out of the question to try and find the retracted, deeply buried arteries, and this seemed to me another ideal case for the temporary transfixion-ligature, which seemed just the thing to close the vessels till I could procure the services of a professional brother to assist me in applying a permanent dressing. I took a short, sharply-bowed needle, armed with small, strong silk, and passed it a little above and below where I presumed the retracted mouths of the arteries were, securing each divided end separately. I used no needle-holder. The ligatures more than fulfilled my expectation, as the haemorrhage was at once and completely controlled. The wound was now thoroughly washed, and wrapped up in antiseptic cheese-cloth, and the arm put in a sling.

An hour later Dr. W. H. Rassman, the family physician, assisting, with a little cocaine applied, I laid bare and ligatured the proximal and distal ends of the radial and ulnar arteries. The wound healed well, and the patient made a good recovery. In this instance the ligature gave an opportunity to apply antiseptic dressings, and to secure skilled assistance.

In doing a herniotomy last March in a badly illuminated room, at midnight, I accidentally divided the internal epigastric artery. The field of operation was immediately covered with blood, and owing to the extent of retraction of the ends of the vessel into the tissues, I failed to secure them. The needle was again called into requisition, this time fixed in a needle-holder. It was pushed right through the tissues under the artery, and tied tightly on the surface of the integuments. The spouting vessel was at once subjugated, and haemorrhage ceased on the drawing of the knot. After the strangled bowel was returned, and the final stage of the operation reached, the mouths of the vessel were sought for, and secured with fine, strong catgut, and the temporary transfixion-ligature removed.

This has been the extent of my experience with this method in closing the arteries in the living human subject. The ease, simplicity, and success with which it has been applied, I think justify me in claiming for it a very extensive range of application, and warrant my strongly urging its general adoption in the surgery of the extremities, the cervical region, and parietes of the great cavities, under many circumstances.

In amputations through the joints I am certainly unacquainted with any other device by which a great vessel can be so effectually, and at the same time only *temporarily*, closed without injury to its structure or integrity, and which does

not require a cumbersome, unreliable apparatus for constriction and assistants for its management.

I greatly regret that I did not have a shoulder joint amputation, in which to demonstrate, in this situation, its advantages over all other methods of controlling haemorrhage. In such a case the ligature would be applied high up, the deltoid flap detached, the joint unlocked, the long blade of the knife coming out *below* the point of transfixion, dividing the bloodless artery in its course. Little blood would be lost except from the terminals of the supra-scapular, and the articulating branches of the axillary artery; but that trifling leakage would be of little consequence, ceasing on adjustment of the flaps.

I am aware that it will be objected that we may lacerate or send the needle through the walls of an important vein, thereby impairing its future integrity, or possibly excite a phlebitis which may put the patient's life in jeopardy by septic contamination. But I answer, that I recommend this bold departure only with the presumption that antiseptics will, in every instance, be applied with the greatest rigour, without the smallest detail being omitted; and, further, that it is of no consequence even if a vessel is wounded under those circumstances, for with the dissevering of the limb it is thereafter forever functionally useless, atrophy and obliteration quickly following.

If surgeons will give the plan here outlined a fair trial, without any preconceived bias or ,prejudice, I feel sanguine it will promptly attest its many merits, and shortly take a recognised place in the *Armamentarium Chirurgicum*. In the hands of the general practitioner, without an elaborate supply of instruments, away from any centre where assistance can be had, this method of controlling haemorrhage may have a happy application; and in battle it may be the ready means of saving many lives.

This ligature may also be applied with advantage in cases of bleeding caused by the rupture of a vein, as in a varix, in wounds or incisions of the neck, in the vicinity of the superficial jugulars, when through pathological changes these

vessels, on division, do not collapse, but have become rigid and distended, a condition known to surgeons as canalisation.

As a prophylactic measure, under these circumstances, in operations on the neck, when the admission of air into the cardiac cavities is dreaded, it is well first to close the lumen of the vessels with the ligature before cutting.

As to the efficacy of this ligature in the treatment of aneurism, looking at the histological elements of the artery and its pathological changes, I feel assured that there is here a wide field for its use. For traumatic or dissecting aneurisms it applies as in amputations. In aneurism resulting from disease, it seems to merit a trial.

The almost insurmountable difficulties in the way of treatment of those pulsating tumors are well known. The degeneration and disintegration of the vessel walls, with calcareous changes, are such that, with the ligature drawn firmly on the bare artery, its brittle, rigid coats quickly give way, and fatal haemorrhage follows. So fearful were the earlier occurrences of this catastrophe that surgeons always interposed bits of linen or doeskin between the ligature and the vessel before ligation was completed. We find Hunter attaching much importance to this detail, and he was imitated by Boerhaave and Anel. I am inclined to regard the advice as sound and practical. The great object in view, in the management of aneurisms, has been to secure the coagulation of the blood within the sac. Surgeons have sought to attain this end by a great variety of methods, but their main reliance has been on pressure, moderate or severe.

Although no opportunity has yet presented itself to test its adaptability in some of those cases, I am confident that the ligature will prove of considerable value here. Any kind of pressure which will divert the blood into other channels will favour the closure of an aneurismal sac. Now, the transfixion-ligature obviates the difficulties encountered with immediate deligation of the vessel or pressure by Esmarch's bandage. In the former, the vessel is compressed tightly with the knot, and the inner coat severed; while with the latter every kind of circulation is cut off, and everything

beyond the rubber is pretty liable to perish. With the temporary ligature the main trunks only are included, and the tension of the silk may be so adjusted as gradually to compress the lumen of the vessel without crushing it.

With small, superficial aneurisms it seems certain that it would work admirably, cutting off the morbid blood-supply without compromising neighbouring tissues. Here its action is similar to acupressure, which was strongly recommended in minor aneurisms by Anel and Delpech; but it fell into desuetude owing to the fact that ulceration and erysipelas often followed its use,—something in these days of antiseptics quite impossible.

I have introduced this method as an accessory to others now in vogue, and not with a view of recommending its substitution for others which have stood the test of time. There are occasions when any given method will fail; and so with the transfixion-ligature, occasions will arise which will prohibit its use. It should not be employed under the following circumstances:

1. In open wounds, when forceps are conveniently at hand, and no large vessel is divided.

2. In haemorrhage, which may be effectually controlled by digital pressure, or by a bandage.

3. In amputations at such a distance from the articulations that the tourniquet or the elastic bandage may be applied.

4. In those cases where the vessels are deep-seated, unless the parts have been horoughly cleaned and the material used is entirely aseptic.

The objections to its use at first sight seem formidable and numerous, but on a careful analysis of them they are not so great as they appear.

I am fully conscious of the incomplete and very limited range of observation which I have had, and the rather random and imperfect manner in which I have, in some instances, outlined the anatomy of the parts to be dealt with; but my aim has been, rather, to call attention to the subject, than to go minutely into detail, as this would carry me much beyond the scope of this essay.