Surgery of the Arteries

E. M. Lawrence
On
some of the more important points
connected with
the
Surgery of the Arteries.

by George Lawrence
Table of Contents

Introduction

The reasons of the author concerning the manner in which hemorrhage from wounded arteries is stopped

Anatomical structure of arteries

An empty orifice of arteries & natural hemorrhage

Practical treatment of hemorrhage

Effects of ligature on an artery

Secondary hemorrhage

Diseases of arteries

Aneurism

Pathology of aneurism

True aneurism

False aneurism

Diagnosis of aneurism

The cure of aneurism

Practical treatment of aneurism

Aneurism in aneurism aneurismal case

Spine aneurism
On

some of the more important points
connected with
the
surgery of the arteries

Introduction.

The surgery of the arterial system is one of the most
important subjects that can command the attention
of the surgeon. From the suddenness, frequency,
of many of the accidents which may befall an
artery, as well as the dangerous consequences resulting
from them, both present and remote, it is necessary that
every surgeon should be able at once to point to the
requisite measures for the immediate arrest of
the hemorrhage.
Section I

Some of the old opinions of Author concerning the manner in which Remorseage from a wounded Artery is stopped.

The opinions of Author concerning the manner in which bleeding arteries are closed have been very various, and in former times very vague.

In 1731 Petit pointed out the formation of the clot, within and without the cut extremities of the vessel, as also in the neighbouring parts as the cause by which the bleeding was stopped after wound of an artery. He considered that every wound of an artery was closed only by the formation of a clot, the he said astringents made close by absorbing the fluid part of the blood, leaving the solid parts to form the clot. The compress he considered a still nearer method of forming a clot, by shutting the mouth of the artery and allowing time for the formation of the clot. From the creature he considered chiefly useful by forming a clot, but which was not nearly so secure as that formed by the compress as whenever the creature came away, the clot was covered, & the Remorseage liable to be
Reproduced. His observations were however very limited and incomplete.

Morand in 1736 showed in addition to Petit's theory, that a change took place in the artery itself which assisted in the stopping of the hemorrhage, but altogether his ideas on the subject were very much confused.

Pott in 1760 rejected the influence of Petit's theory, and denied that of Morand. He considered that it was the swelling of the surrounding cellular substance that compressed the artery and so stopped the blood. His theory was founded upon dissections of the Femoral artery sometime after it had been tied in amputation. He says: "I have dissected a Femoral artery three weeks after it had been tied in amputation, but in it I found nothing of all Petit's clot, nothing to close or compress the artery except merely the thickening of the surrounding cellular substance, for the ligature was loose about the artery. The Canal of the artery was Conical, growing narrower the nearer to the ligature. Immediately under the ligature, it was not obliterated, but was much thinned; it
was only below the ligature that it was entirely 
straitened, ending in a short time.”

Such was Pasteur’s theory & his reasons for 
forming it, and hence follows his practice.

“...But if it is once proved that the swelling of the 
parts surrounding the ligature, produces the 
principal obstacle to the flow of blood, from the 
Artery, it is natural to conclude, that the more 
of this swelling the greater will be the resistance 
to the flow of blood.”

Next the theory of the Natural contraction 
of the Arteries, as the Cause of the Stophpage of the 
Hemorrhage was introduced by Mr. Whyte and 
Mr. Kirkland.

In 1806 Mr. Jones pointed out the 
error of all the former, in attributing all the result 
to only one of the attendant circumstances. He 
held that the stoppage of the flow of blood from a 
warounded Artery was accomplished by several 
means, in fact that all the parts concerned in, 
or affected by the Hemorrhage, were concerned in 
the process of its stoppage.
Section II.

Before enquiring into the manner in which the hemorrhage from a wounded artery is stopped, it may be well to consider shortly the

Anatomical Structure of Arteries.

An artery when viewed by the unaided eye is seen to consist of three coats, viz an internal or serous, a middle or fibrous, and an external or cellular. Under the microscope five layers can be distinctly made out. The innermost (of those seen by the naked eye) being composed of two, the middle of three. The innermost of these five layers is composed of a tesselated epithelium, which is quite analogous to that of other serous membranes. The next is a thin rigid membrane pierced with a number of round or oval foramina, supporting a thin layer of longitudinal fibres. From these characters it has been denominated the striated or fenestrated layer. The third layer or innermost layer of the middle coat, is composed of flat longitudinal fibres, analogous to, if not identical with, the muscular fibres of organic life. The fourth layer is composed of circular fibres, which are similar...
in structure to the longitudinal. This is the thickest layer of the whole. The fifth layer consists of a thin stratum of elastic tissue and is present only in the larger arteries. The sixth or external layer consists of areolar-fibrous tissue. As the branches advance towards the periphery of the body this layer can no longer be traced. As the advance further we find only three layers, then two, and even these become ultimately blended together, until in the capillaries we find only a membrane, in which nuclei are scattered here and there. For surgical purposes it is quite sufficient to consider an artery as consisting only of three coats, many however add another which is named the adventitia and is situated between the middle and internal coats. The internal or spongy coat is very brittle, especially transversely, and is well supplied with bloodvessels. The middle coat is very thin in the arteries of the brain. Thus an artery gives off branches or divides, the middle coat can be seen to divide in such a manner, that at each division, there is a
space in which the fibres of this coat are wanting, so that the vessel at such points is necessarily weaker. This coat is possessed of considerable elasticity, so that the vessel keeps its circular form in the dead body. It also possesses a certain degree of contractility. This coat is easily lacerable in all directions, but especially in the transverse. The external coat consists of condensed cellular membrane, and on this the chief strength of the artery depends. It is a white dense like fascia, possessed of great strength, as is well shown when an artery is ligatured, the two internal coats rupturing, while the external alone remains entire. Its characters are lost in the hairs. The fourth or sclerous coat consists of a hard and thick membrane of a whitish colour varying in thickness according to age. Nodoid deposits in the coats of arteries take place between the inner coats, and by some (Malgaigne) are referred to the sclerous. The arteries are confined by a sheath, to which they are connected by fine cellular membrane. This sheath becomes less distinct as the
arteries decrease in size. This sheath contains also the vein, and between the artery and its sheath pass the nerves to the (causes). The arteries under increased action are capable of considerable enlargement, again resuming their normal size as soon as the cause of the change has passed away; as is well seen in the pregnant uterus.

Section III.

On wounds of arteries and the manner in which hemorrhage from them is stopped.

When an artery is wounded, the blood instantly springs in jets of a bright color. This hemorrhage goes off until it is stopped by nature or artificially, or else the patient dies.

When completely divided, an artery by virtue of its elastic nature retracts without its sheath, which then, without this elasticity, is left vacant and rough, and thus in a great measure
favours the coagulation of the blood. At the same time while the artery retracts within its sheath, its contracts in its calibre, thus producing a mechanical obstacle to the flow of the blood. When the obliteration of the main trunk is complete, this contraction goes on increasing as far as the nearest collateral branch. Along with this contraction of the vessel there is the formation of the clot. This is partly external to the vessel and partly internal, the latter adhering to the inner side of the inner coat. There is also an amount of extravasation of blood into the surrounding cellular tissue between the external coat and the sheath of the vessel, and also into the tissues external to the sheath. All these causes together with the diminished force of the circulation caused by the loss of blood assist in the closure of the wounded artery. When an artery such as the common carotid is wounded, all the phenomena now mentioned have not occurred ere the patient die, (if the hemorrhage is not stopped artificiously but in a vessel such as the radial artery)
the hemorrhage goes on until syncope supervenes. As soon as this occurs the hemorrhage stops, and the longer it continues the larger and more firm is the clot which is formed. On re-acting taking place the clot may be displaced and the bleeding renewed until again followed by syncope. Such states follow each other in succession until the patient dies. If small vessels should the clot not be displaced by reaction, the permanent closure of the wound is effected, lymph is exuded from the cut vessel, and from the whole of the wound into all the tissues concerned, so that in a short time it becomes very difficult to distinguish one tissue from another, and as the organization of this lymph proceeds the parts become more and more consolidated. The coagulum which was previously formed, has now served its end, and is removed by absorption. The collateral circulation is increased, and the contraction between the first onset and the wound goes on increasing until it finally becomes converted into an impervious cor.
By the process of absorption still going on, the plastic exudation is in time removed, and the consolidated artery shrinks down to a mere thread. Such are the procedures by which spontaneous cures are effected after complete divisions of an artery.

In cases where the artery is only partially wounded, the hemorrhage is arrested with much greater difficulty than in cases of complete division, as there can be no retraction of the artery within its sheath, nor contraction of its calibre. It is for this reason that when small vessels such as the Temporal artery, are partially wounded that surgeons often insert the point of a lancet (and effect complete division). In such wounds there is often great danger of the hemorrhage proving fatal, if Nature's efforts are alone trusted to, especially if the artery is of any size, and near the heart. In such cases, when Nature effects a cure, the blood seems to be infiltrated into the cellular substance between the sheath and the artery, and also into the tissues external to the...
sheath. The pressure so produced, moderate to a degree, the flow of blood through the arterial puncture. The greater the amount of infiltration, the more is the relative position of the parts changed, causing the back of wound to become oblique, and the sheath to overlap the puncture spot in the artery. Frequently also a clump forms in the arterial wound, but this is very liable to be again displaced, or reaction of taking place. The evolution of plasma takes place as in complete division of the artery, only it frequently happens that it is not so copious as completely to obstruct the arterial passage. The direction of the wound of the artery has considerable effect upon the size of the wound produced, and consequently upon the amount of hemorrhage. Longitudinal wounds produce only a very slight aperture, while oblique wounds have apertures proportionate to their obliquity, being the smaller the nearer they approach to the transverse direction.

When an artery is torn across, the effect produced are very different from those produced when it is cut. There is little or no bleeding.
Even the auxiliary artery may be torn across and little or even no blood be lost, as the natural hemostatics are much more readily effected. This is caused by the coats giving way at different times, which prevents their retracting together. The inner coat gives way first, while the external coat is drawn out for a considerable distance (sometimes even an inch) before it gives way. Being thus drawn out, it forms a pouch into which blood is extravasated, and a coagulum forms. The exudation being then thrown out causes the clot to become much formed, thus resist the force of the circulation, which is otherwise far more apparent than real.

Oclusion was at one time much relied on for the stopping of arterial hemorrhage, but it has now in most cases very properly given place to the ligature.

There may be a wound of one or more of the internal coats of an artery, and yet the external coat remain intact, having resisted the violence. This is often seen in cases where a wagon wheel has passed.
Section IV.

Surgical treatment of hemorrhage from wounded arteries.

When the surgeon is called upon to arrest hemorrhage from an arterial wound, the first point in the treatment he ought to follow, is to make pressure with the point of his fingers or thumb upon the bleeding point. This pressure must be applied directly to the wounded bed.

This procedure, having arrested the hemorrhage, a graduated compress is to be applied directly to the bleeding point, and secured with a roll of bandage. This is quite safe for the time until preparation be made for the application of a ligature, which is quite necessary in all vessels of considerable size. In smaller vessels the compress and bandage is quite sufficient. When it is necessary to trust to the compress and bandage for any time...
on the absence of the surgeon, it is proper to leave a tourniquet loosely applied to the principal vessel, so that should any hemorrhage occur it may be commanded until aid be obtained. It may be considered as a general and safe rule, that if there is obvious bleeding, evidently from a large opening, and especially if there is infiltration of blood into the cellular tissue, a ligature should be applied immediately. Before applying the compress, the wound of the artery must be thoroughly exposed, and all clotted blood that may be lodging in the track of the wound completely cleared away. In cases where the compress and bandage is trusted to, as in the Case of wound of the vessels of the forearm, the arm must be bandaged from the fingers upward to give support to the parts, as there is considerable danger of gangrene supervening. If the pain is not very great the compress is continued for three days. It may then be removed and applied more lightly. The arm must be kept raised, and the patient sub-
jeted to antiphlogistic treatment. In cases
where the bleeding point is very deeply seated
and not well seen, it is necessary to enlarge
the wound and secure it with a ligature.
but in cases where after all it cannot be
secured, recourse must be had to the com-
press.

The Ligature

The application of a ligature to a wounded
artery has been long known, but not until
recent times, was the manner of its applica-
tion and the effects produced by it properly un-
derstood. As this is at present the only
efficient means for the obliteration of a large
artery, and as the success of the operation
depends much upon the manner in which it is
applied, the following points require attention.

The external incision should be free
enough to enable the operator easily to reach
the vessel.

The external coat of the vessel should be
carefully removed, so that nothing more than
the vessel be included in the moose of
the ligature.
The artery should be separated from its connections to the least possible extent and the passing of the needle should be accomplished with the greatest gentleness and caution.

The ligature should be drawn with force sufficient to divide the internal and middle coats of the artery.

The greatest care should be taken that the veins in the neighbourhood of the artery are neither wounded nor bruised.

The ligature should be strong, thin, and well waxed: and the wound should be dressed so as to favour, as far as possible, primary adhesion.

In ligaturing an artery for wound, two ligatures must be applied, the one above and the other below the bleeding point.

Occasionally, two ligatures will not command the hemorrhage, on account of a branch being given off, exactly at the wounded point and here of course one additional ligature will be required.

The formation of false aneurism.
is no uncommon result of the pressure employed in treating wound of an artery by that means, especially when the wound is of considerable size. A pulsating tumour is the result, which requires the same treatment as wound of an artery, and when such an aneurism is opened accidentally or spontaneously, the same plan of treatment is still to be followed.

An artery may give way by ulceration or sloughing when the parts surrounding it are in an unhealthy state. Ligatures placed above and below the opening in such a condition, can be of no great utility. A ligature must then be placed upon the vessel according to the Hunterian method, at a distance from the wound, and upon a sound part of the vessel. The coats of the vessel from the injury they may have sustained may not have power enough to take on the healthy action necessary for occlusion, and may even be so injured as not to bear the ligature. In some of these cases a single ligature, applied according to the Hunterian
Method may be resorted to. When this fails compression of the bleeding point must be tried, but owing to the state of the vessel it is obvious that firm pressure cannot be employed.

When all fails our only resource is amputation above the bleeding point. Mortification of the acute kind often follows obliteration of the main artery of a limb, more rarely however after obliteration of the main artery of the superior extremity, that of the inferior. Amputation in spreading gangrene if ever advisable is only so in this case, the operation being performed above the point where the vessel is obliterated.

Section V.

Effects of Ligature on Artery.

When a ligature is drawn tightly round an artery, the two inner coats are divided and
thrown into folds. The cut extremities curl up and close up in part the interior of the vessel, while the external coat remains quite entire. Inflammation is produced, lymph is exuded, and by this the breach of the vessel made by the division of the inner coat is filled up. In a short time the ligature round the external coat produces ulcerations which at length lets free the ligature, which is discharged. During this process lymph is exuded both into the interior of the vessel, and into the surrounding parts, which thus maintains the continuity of the vessel. The artery gradually contracts above and below the part where the ligature was applied, as far as the first effort; this intermediate contracted space becoming converted into an impervious cord. The size of the coagulum which forms on each side of the ligature is in a great measure dependent upon the nearness of the first collateral branch, as well as upon its size. For example if a ligature is applied to the Common Carotid artery shortly above where it is
given off from the brachiocephalic, the size of that vessel as well as the impetuosity of its current of blood through it, render it impossible to have a large coagulum. Whereas, were the ligature applied somewhat higher up, the blood being much more at rest, is in a condition much more favorable to the formation of a large coagulum. The clot lies for the most part loosely in the canal of the vessel except at the point of division where it is firmly attached to the exudation. It is on the process of the coagulation of lymph that its organization, that the obliteration of the artery depends, and not upon the coming away of the ligature in attendance of the ligature where it is fastened before the exudation becomes organized, that will be secondary hemorrhage.
Section VI.

Secondary Hemorrhage.

Of all the dread casualties that may result from the operation of placing a ligature upon an artery, the principal is secondary hemorrhage, or bleeding occurring some time after an artery is ligatured; this bleeding being caused by ulceration or sloughing. This in general is found to depend upon the following causes.

1. The application of the ligature being improperly performed, there may be too rough use of the ancimien needle. The vessel may be exposed to too great an extent. The ligature may not be drawn with sufficient tightness, so as clearly to divide the internal and middle coats, thus necessarily producing a large slough of the included tissues, inducing a correspondingly amount of ulceration and sloughing, and at first not permitting the retraction and contraction of the coats so favourable to adhesion. The rule laid down
by some, to draw the ligature with all the force possible, should not be followed as it is not always safe. It should be drawn with considerable force, the extent of which is very easily known by the peculiar sensation imparted by the division of the coats.

2. The coats of the vessel may be in an unsound or diseased condition, and be not capable of taking on a healthly action. The artery being too extensively separated from its surrounding connections loses its vital powers from imperfect nutrition.

3. An unhealthy condition of the external wound. Erysipelas may be induced. Abscess may form in the surrounding tissues, interfering the plastic circulation, and by its pressure effecting ulceration of the arterial coats from without.

The time between the application of a ligature to an artery and the cicatrisation of the wound varies in general from six to twenty days, but danger continues for some time after the ligature has come away. Then secondary hemorrhage does come on, there is
generally at first a mere oozing of blood, some time after a few ounces may escape, and this again is seen followed by a full continuous stream. It is not uncommon for a little bleeding to take place when the ligature comes away properly, but such is generally cured spontaneously.

Secondary hemorrhage is often preceded by marked febrile accession of considerable import to theAdobe, as a warning of the approaching danger, thus giving him time either to arrest it, or prepare to meet its first commencement. In cases of secondary hemorrhage after amputation of limb, the treatment depends upon the amount of bleeding. If it is only slight, the raising of the limb, and the application of cold water usually suffices. If the bleeding is more copious, the whole extent of the wound requires to be laid open, and a Compress applied. If this is not sufficient, the coat of the vessel is to be laid bare for some distance, and a ligature applied at some distance higher up. In the event of this proving insufficient, secondary amputation is the only resource which affords a chance of cure.
Some other plans are sometimes tried, as the actual cautery and strong escharotics. The cautery is a powerful means of arresting hemorrhage, especially when it is from a number of small vessels, but in the case of large trunks, the hemorrhage is most likely to be renewed, after the separation of the sloughs.

Section VII.


The arteries are subject to inflammatory action. This is sometimes seen to be connected with the formation of aneurism, and with the depositions that frequently take place in the arteries of old people. In general, the immediate cause cannot be distinctly ascertained. Sometimes it seems to be caused by exposure to cold, by the pressure of tumours, and by external injury, but this last named cause
is very rare indeed, and when it does occur, is often followed by acute gangrene. It is accompanied by sharp, shooting pain, and the vessels along their course feel indurated and swollen. The pulse is feeble, and has a peculiar thrumming stroke; its impulse diminishes until ultimately it wholly ceases in the part. There is much constitutional disturbance of the sebile kind, of the irritative type. When the inflammatory action is of spontaneous origin, it in general commences in the larger vessels, and is often followed by dry, chronic gout. It is generally present in one vessel at a time, and sometimes even affects the whole system. There is generally want of the external signs of inflammation, and the case is often treated as a neuralgic affection. When the diagnosis is distinctly made out, by the signs of obstructed circulation, manifesting themselves, the patient is subjected to rigidly antiphlogistic treatment until the gout is affected. When the
Approaching symptoms of gangrene are manifesting themselves, the first, second, and third, to support the vitality of the part which is best accomplished by keeping the limb warm, by rolling in flannel and cotton wadding, and secondly, we must endeavour to arrest the inflammatory action, by leaching along the course of the vessels, and continuing the mercurial. The gangrene is characterised by very great pain throughout its whole course, even after the line of demarcation has formed. Amputation should not be performed until the line of separation is considerably advanced.

Occasionally a limb becomes cold and pale, while suddenly gangrene commences without any previous symptoms of disease of the vessels, nor can it be attributed to external causes. In addition of such cases the main vessel is found firmly plugged by a mass of lymph, the inflammation causing this having probably been subacute.

Inflammation of a chronic type, is much more common, and is usually of...
Spontaneous origin. It is in general in persons of an advanced age that it is found, and more frequent ly in males than in females. It is often found in persons whose constitutions have been destroyed by intemperance, surgical poisons, or abuse of mercury. Frequently, it is found connected with hypertrophy of the left ventricle of the heart, and associated with the rheumatic diathesis. It is gradual and insidious in its progress. There is considerable structural change produced in the vessel, affecting a bend throughout its whole extent, or occurring only in isolated patches, chiefly about bifurcations or the orifices of large branches. The internal coat is thickened and rough, and the depositions take place between the internal and middle coats, or, as it is termed in the delirious coat.

These depositions have been termed,

1st. An atheromatous or fatty,
2nd. A stenomatous or fatty,
3rd. A cartilaginous,
4th. A calcareous,
5th. An osseous.
The two last mentioned are almost the common rule in old people. Unless this has taken place to any great extent, or throughout the whole system, it does not materially obstruct the circulation. This condition greatly complicates operations in old people, as the sharp spicule of bone protrude through the vessel. In cases where there is a deposition of caseomatous matter, the middle coat is also found altered, in consequence of which the elasticity of the vessel is much impaired and thereby rendered very liable to be torn if forcibly stretched. If torn it is found to be less capable than natural of throwing out plastic exudation, and that ulceration is far more likely to supercede. Under such circumstances it can be at once understood, that the formation of lincreism is much favoured. This deposition is often found in advanced life, is by no means confined to it, but is very frequently found in persons between the ages of 25 and 50.
Section VIII

Aneurism.

An aneurism is a pulsatory tumour containing fluid and coagulated blood within its cyst, and communicating with the interior of an artery.

Authors have made many divisions of Aneurisms, as External, and Internal, the former so situated that they can be surgically treated, the latter, quite beyond the limits of surgical interference.

Again they are divided into true and false, the former those in which one or more of the coats of the artery remain entire; in the latter all the coats are divided, and the blood accumulates in the cellular tissue external to the vessel.

In the true aneurisms, all the coats, or the external coat alone, may remain entire. False aneurisms may be formed by wound of all the coats of the vessel, or by the bursting of a true aneurism.
Sometimes it is caused by the burrowing of an Abscess under the Coats of an Artery, the Coats become destroyed by ulceration, and the cavity of the Abscess becomes converted into a false Aneurism.

The term Circumscribed is applied to an Aneurism so long as it is confined within the limits of a proper Cyst. The term Diffuse is applied after it has burst through the Cyst, or been originally devoid of one. In such cases the blood is widely diffused by infiltration into the surrounding tissues.

Aneurismal Varix occurs, when there is a communication between the Artery and Vein, as occasionally happens when the Brachial Artery is punctured, when the section is performed. The superficial wound of the vein closing with the integumental, and the cyst having a double communication, with the vein above, and with the artery below. The arterial blood escapes very readily into the vein, which is more or less distended.
Aneurism is termed sacculated when the inner coats of the artery, having given way, the blood frees a passage along the middle coat, forming a long pouch or bag.

An aneurism is termed injured when there is a protrusion of the external coat through an aperture in the internal.

Aneurism by anastomosis as it is termed is generally of congenital origin. It is a tumour of erectile tissue more or less elevated, and of a purplish colour. This ought not to be termed an aneurism, but an erectile tumour.

The general signs of an aneurism are:

1. Pulmonary movements synchronous with the impulses of the artery, the pulsation being of an expanding nature
2. Resistance of the tumour by compression of the vessel, between the tumour and the heart, and the return of the tumour to its ordinary size (accompanied by a Bruit de sangjet) after the pressure has been removed.
3. The functions of the neighbouring parts
Pathology of Aneurism.

Occasionally an aneurism is formed by dilatation of all the coats of the artery. When formed in this way, the process is in general very gradual, and the coats become flaccid. Occasionally, however, from the presence of atheromatous depositions, the coats are thickened. Aneurisms formed in this manner are most commonly, if not always, found in the aorta, and the vessels within the cranium. The expansion of the coats is not uniform, but it proceeds always from one point, and is confined to only one side of the vessel. Before the tumour attains any consider-
able size, the internal coats give way, leaving only the external coat intact. When an aneurysm forms, the fibrine of the blood lines the interior of the sac at every point in consecutive layers, those first deposited being firmer, and of a pale yellow colour. The more recent the deposition of the fibrine the softer is its consistence, and the more red its colour. Such is always the case in all true aneurysms, however small they may be, and may be ascribed to the morbid condition of the coats themselves, or to the slowness of the movement of the blood in the tumour, owing to its being diverted from its proper channel. This fibrine layer becomes organised.

The incrustation of the blood between the layers of the fibrine, is the insurmountable precursor of the bursting of the aneurism.

From the time of the commencement of the dilatation of the vessel, an exudation of plastic lymph takes place from the internal coat around the edges of the opening. This seems to be a sort of
boundary set up by nature to limit the extent of the disease of the artery.
This thickened edge is always well defined. When an aneurysm first forms the opening between it and the artery is oval, but as the disease advances it becomes irregular, and even in some cases the artery is entirely divided.

Aneurysm has a tendency to extend towards the surface, whence the blood escapes externally, or it tends towards some internal cavity or outlet, when it reaches the surface the vein becomes thin and discoloured, and ultimately a patch sloughs. Around the edges of this slough, the coagulum begins to protrude, and the blood to ooze away, but far more frequently the patient is at once carried off by the hemorrhage.

The predisposing causes have been described by different authors to be Scurvy, Syphilis, Mercury, Rheumatism, Gout, and the too free use of alcoholic spirits, the proximate cause being that
ever ruptures the artery at the time of the accident. Those accustomed to the very free use of ardent spirits accompanied by hard exercise, are the most common subjects in whom aneurism occurs.

Aneurism is far more common in man than in women. In man it is found most frequently in the lower half of the body, while in women it is found most frequently in the upper half. The period of life during which its occurrence is most common is between the ages of 25 and 50. The youngest patient upon record is one on whom Professor Syme operated a boy of nine years of age. The curves of arteries, and the places where large branches are given off, are the most common situations of aneurism. Spontaneous aneurism of any of the arteries of the arm, below the Brachial is extremely rare. If after ligation of an artery for aneurism, another aneurism should form in another
Bessel, we are not to be deterred from ligaturing that vessel also, for numerous successful cases of such are on record. For example, both femoral arteries have been tied in one person, for popliteal aneurism, with the best success.

True aneurism may be formed in various ways.

1st. By dilatation; this is only found in the large arteries, and most frequently in the aorta. The coats do not give way, but dilate evenly, and in them plethromatosous deposits can readily be recognized. This dilatation may be confined to only one side of the vessel, or the whole tube may be enlarged.

2nd. By dilatation with rupture. This form at its first commencement is occasioned by the dilatation of all the coats. The internal coat, by the pressure exerted constantly upon it, either pleatates, or tears, giving some sudden muscular elevation. At the same time, the middle coat may also
Give way, the blood resorbs itself into the aperture, gradually causing the external coat to expand. The cyst is also gradually strengthened, from within by the fibrine deposited from the contained fluid blood, and from without, by the condensation of the surrounding tissues occasioned by the continual pressure of the expanding tumour. This is the most frequent sort of Aneurism.

3. By rupture of the internal and middle coats. Its appearance is sudden and its immediate cause is in general some great and sudden muscular exertion. There is always the predisposing cause of atherosomatous degeneration in operation, which prevents the tear of the internal coats from healing.

False Aneurism

may be produced

1st. By direct wound of an artery.
The blood immediately escapes in great quantity and with considerable force, and by its pressure
Condenses the surrounding tissues, thus forming for itself a cyst, which is strengthened in the ordinary way. When false aneurism is produced by laceration, the results are quite similar to those produced by direct wound.

1st. It may be formed by the bursting of a true aneurism, occasioned by the increasing pressure of the constantly accumulating fluid in its cavity.

2nd. It may be produced by the bursting of an abscess round the coats of an artery, and these coats giving way by laceration. An abscess forms in the neighborhood of an artery, the approach of the pus to the surface is prevented by firm fibrous investments, it burrows round the coats of the vessel, and by the increasing pressure laceration of the coats is produced, and the blood escapes into the cavity of the abscess, the walls of which are strengthened by the fibrous exudation formerly thrown out.

False aneurism has no character.
The Diagnosis of Aneurism.

To distinguish an Aneurism from tumours containing fluid, situated over an artery, and from tumours of great vascularity, having a regular pulsation and expanding movement.

1. By raising the tumour gently from the artery. This procedure produces no effect upon an Aneurism, the pulsation in the cyst is in all directions the same as before. If the tumour is not an aneurism such a procedure usually removes all pulsation.

2. Compression of the edge of the aneurismal tumour, by compression of the artery between
the tumour and the heart. This is best seen in the early stage of aneurism, but at best is deceptive. Roentgenic indications are also very deceptive, such as the Bruit de Bouchet, which may be heard where there is no aneurism and may be absent where an aneurism plainly exists. It is however of considerable importance in the early stage.

2. Emptying of the tumour by steadily pressing upon its surface, is one of the best indications of the existence of an aneurism.

When after careful examination of the tumour doubts as to its real nature still exist, the exploring needle should be employed. It has been said that this is apt to give rise to hemorrhage that can with difficulty be arrested, or may induce inflammatory action in the cyst. Any risk of bleeding may very easily be overcome by applying a ligature around the opening, or by inserting the needle obliquely. Such a procedure however should be had recourse to, only as a last resource, and where the surgeon is ready to operate immediately, should it prove
of such a nature as to require operative interference. When an Aneurism is large and nearly filled with fibrous deposit it is often very difficult to distinguish it from other tumours, as there is very little, or it may be no pulsation. On the other hand, the great difficulty lies in being apt to mistake another tumour for an Aneurism.

To distinguish Aneurism from Abscess. An Aneurisinal tumour is at first soft, well defined, pulsatory, and increasing in solidity as it increases in size. On the other hand, Abscess is at first hard, not well defined, and becomes softer as it enlarges.

To distinguish Aneurism from Expected tumours situated over an Artery. Expected tumours have no pain at their commencement, and no pulsation until they come to be of considerable size.

The most common difficulty in the diagnosis of Aneurism, is to distinguish it from the Cerebral or growth. The ante-
ceedent history of the case, and the exact nature of the pulsation, are the principal indications to be relied upon. A particular point to be observed in the case of the cerebriform growth is the continued emaciation of the patient as the tumour increases in size.

Encrusted tumours of the neck, and enlargement of the thyroid body, are often difficult to distinguish from Aneurism, in the last named, the tumour is observed to move along with the larynx.

On the Cure of Aneurism.

In Aneurism the collateral vessels become gradually enlarged, so that ligature of the main artery or a band for Aneurism is accompanied by far less risk of gangrene supervening, than when it is ligatured for wound, as in the latter case the collateral vessels are called upon suddenly to perform a great amount of increased action. False Aneurism is treated the same as if it were wound of an artery.
Aneurism may however be cured spontaneously in three ways.

1st. By the deposition of fibrine layer after layer, within the sac, until the whole cavity is entirely filled. This process goes on for some distance in the vessel.

2nd. The fibrine is again absorbed. The spontaneous cure seems to depend much upon the clip of the collateral vessels, and the rapidity of the circulation through them.

Sometimes after spontaneous cure the artery is left permeable, but this is very rare, especially in internal aneurism.

3rd. By gangrene consequent on inflammation of the sac, the artery being rendered impassible by exudation of lymph. Cure by this method can only take place in
the advanced stage of the disease. It is sometimes induced by the too frequent and rough handling of the tumour, and by too free diet. Sloughing may be caused by extreme tension. Inflammation of the whole eye, is accompanied by very severe pain in the tumour and lids, and also by severe constitutional symptoms. The eye sloughs, and the artery is obliterated by the free deposition of caspicous lymph within the vessel as far as the nearest collateral branches. The occurrence of spontaneous cure in this manner is very rare indeed.

3. By pressure of the aneurismal tumour upon its vessel. Spontaneous cure in this manner is doubted by some, unless in cases where the artery is subjected to constant pressure. A considerable amount of pressure is desirable, and in fact necessary for the production of the occlusion of blood. Necessary to close the vessel, but on the other hand it is not necessary that the vessel be quite obliterated.
In internal aneurism, the treatment is medical. That commonly called Valvins's treatment is usually adopted. The patient is placed in the recumbent posture, and is put on as low a diet, as is capable of sustaining life. Blood is at first drawn in large quantities, and afterwards in smaller, until the patient is reduced to as low a state as possible. Medicines which reduce the action of the heart and arteries are administered, such as, Digitale, Lead &c. Cold by means of ice and snow is applied, and bandages where admissible.

Surgical treatment of Aneurism.

For the surgical treatment of Aneurisms, two methods are at present employed, viz. treatment by ligature, and treatment by compression. The profession is still very much divided in opinion concerning which is the best plan of treatment, the one method having its
special advocate for its decided superiority over the other.

The treatment of Aneurism by compression was first tried by Bayen and Deschamps, in whose hands it failed. Since then until the practice was reintroduced by the Irish School it had fallen into complete disuse. As far as gone the practice has not been very successful in this country, and altogether as compared with the treatment of ligating the artery, the results of the treatment by compression do not appear very satisfactory. Compression of an Artery cannot be well accomplished, without involving the vein in the pressure, and sloughing, with other bad consequences have resulted from this. The operation is very uncertain, and the Cure very often long protracted, while in many cases the pain is insufferable.

On the other hand it must be admitted that many cases of successful Cure have been accomplished.
And that upon the whole it seems at present that there are some cases in which the treatment by compression is preferable, while at the same time it is perfectly obvious that there are cases in which the immediate application of the ligature is most decidedly required. It must therefore at present remain to be seen which operation is attended with least danger to life. The plan deserves a fair and honest trial, and if ultimately found to be the safest will justly come into more general practice.

1st Treatment by Ligature. The Hunterian Operation.

A ligature is placed on a sound part of the artery, at a distance from the aneurism, between it and the heart. The first effect is immediate elimination in the life of the tumour, and cessation of the pulsation. The temperature of the limb rises a little after the operation, but again gradually declines, until it comes to be the same
or even less than that of the other limb.

In time the tumor becomes solidified and ultimately is altogether absorbed, and there remains only a little thickening at the point where the aneurism previously existed. As a general rule, the operation does not answer in Traumatic Aneurism, but there are exceptions to this as Traumatic Popliteal Aneurism. The Axillary, the Carotid, the External Cune, and the Femoral Arteries, are the vessels in which the Hunterian operation is preferred. The ligature for an artery need previously to consist of a bundle of string wound together, and between it, and the vessel was inserted a piece of adhesive plaster. This ligature was only tied with sufficient force to bring the sides of the vessel into contact. Such is Hunter's old method. He also had two ligatures of reserve ready to be tied if necessary.

Before performing the operation, the patient ought to be kept for a day or two in the recumbent posture, Repet
on low diet, and the force of the circulation diminished as much as possible. A purge should be given the day before, and a bandage applied round the tumour.

The operation having been performed, the after treatment is to be conducted as to favour primary union. If congestion occurs, the limb is to be raised, and if heat is much complained of the dressing should be removed, and the part exposed to the air. If the limb is pale and cold friction should never be employed, but the limb may be wrapped in flannel or cotton wadding.

The solidification of the tumour may go on slowly and after a time inflammation may occur, the firm tumour acting as a foreign body. A bandage applied for some weeks after the operation favours absorption of the tumour. The laying open of the tumour in the lowest or breast should never be used because, as the sac is still liable to suppurate, and from such sup-

...
operation the patient often suffers. When
the tube is in a curling state, amputation
should be performed immediately.

Gardner's operation.

this operation was given up until
about 50 years ago, when it was revived by
W. Warburton. It is applicable only to
the Carotid and Aneurismal arteries.
the ligation being placed on the distal
aspect of the tumour. The most common
cause of the bad results of this operation
is the ligation being placed too near
the Aneurismal tumour and con-
sequently on a diseased part of the
blood. This mode of operation is only
admirable, when the ligation cannot be
placed on the Carotid aspect of the tumour
and when no branches is given off between
the ligation and the tumour.

Treatment of Aneurism
of Compression

This may be done in various ways.
1st. When the pressure is applied directly to the tumour.
2nd. When applied to the tumour, and whole limb, as by a bandage.
3rd. When applied to the artery between the aneurism and the heart.
4th. When applied both to the tumour and to the artery above it.
5th. When applied according to Draydor's method.

The third is the only method now generally employed. Formerly, the object desired was obliteration of the artery at the point of compression, but it is now known that this is quite unnecessary. The spontaneous cure is favoured by all the means that diminish the force of the circulation. And for this compression answers very well. When the fibrine is deposited in layers within the tumour, the circulation may go on briskly above the obliterated part without any risk to it, so that upon the whole compression in such cases has the same effect as a ligature. Compression
is only applicable to aneurisms of the extremities below the groin, and axilla. The time for the continuance of the pressure varies in general from a few days to three months, the average time being six weeks, but cases are on record in which as many or even a greater number of months have been necessary. A considerable number of cases have occurred, where compression has been employed for months, and had ultimately to be given up and ligature applied. It appears, however, that previous treatment by compression, in no way complicates the after-treatment by ligature; it, in fact, assists it, by increasing the collateral circulation. When the aneurism is of recent formation, compression is of use in arresting the flow of blood, and of increasing the collateral circulation. When it is of old standing, firm, and undiminishing, in cases of arterial disease, and double aneurism, the ligature is obviously useless and in such cases compression may, and ought at least to have a trial.
ligature ought undoubtedly to be applied in cases.

1st. Where the tumour is increasing rapidly in size.

2nd. Where there is severe constitutional irritation, and

3rd. When the distal part of the limb is cold and congested. In this case it is plain that compression cannot be used, as of necessity the vein is compressed along with the artery. The temperament of the patient, and his power of enduring pain ought always to be taken into account. When the treatment by compression is thought of. The same preparatory treatment is necessary, as before the operation by leucorrhea, and during the whole period of treatment, absolute repose with re-cumbency is necessary. The patient must be placed on antiphlogistic regimen, and all means likely to favour the desired change must be adopted. The limb below the compressed point must be uniformly supported by bandaging, lest passive congestion and edema...
The instrument found most useful for compression is a modification of the Carpenter's clamp. A moderate degree of pressure is applied to the vessel at a point where its coats are expected to be in a sound condition. This pressure is continued only so long as it can conveniently be borne by the patient, and as soon as the pain becomes severe, with swelling and numbness of the limb, and throbbing in the part, the pressure is immediately removed. Instead of employing one instrument it is better to use two or more compressors, where this can be conveniently done, the one being slackened and the other alternately with the other. By this means the pressure is diffused, and far more easily borne by the patient. The counter pressure is also diffused, by placing a splint of pasteboard, between the skin and the back of the instrument.

The circulation in the humerus is moderated at solidification gradually commences. Ultimately the tumour begins to decrease.
in size. The pulsation becomes less and ultimately altogether ceases. The tumour becomes perfectly indurated. Absorption then commences its work, and the old literature cure is obtained, with or without a previous condition of the beard.

Treatment of Aneurism by
Sclavani-Prunier.

Sclavaniism is passed through the tumour by needles inserted into the sac. This coagulates the mass, but as it is only the albumen that is acted upon, the coagulated mass is loose and spongy. Two long needles are inserted into the sac about its middle, these are connected with a moderately strong battery, and are moved about with the tumour, their points never being allowed to come in contact.

From twenty minutes to half an hour is the average time required. It has been followed by bad consequences and its application ought to be confined
to those cases in which Brande's operation is applicable. As it causes very severe pain of a burning character, the patient ought to be placed under the influence of Chloroform.

A new method for effecting the coagulation of blood, by a concentrated solution of the Perchloride of Iron, has been introduced by Dr. Frans of Lyons.

At a meeting of the Académie des Sciences, he recommended it for the cure of aneurism, by injecting it into the sea. The affinity of the Perchloride of Iron for albumin is said to be so strong that coagulation takes place as soon as they come into mutual contact.

The clot formed is said to be so solid and firm, that no fear need be entertained of any threads being washed away by the circulating current.

After this method was recommended, it was tried by M. de-
longIchamps of Lyons, with good results. It has also been since tried by Professor Syme, but the result in his case was unsuccessful. Trials of this method, should as yet be confined to the smaller aneurisms.

Amputation of the limb for aneurism is the last resource of the surgeon, but it absolutely required.

1st In cases of suppuration of the toe subsequently to the application of a ligature.
2nd When the tumour is very large, and where the neighbouring parts are disturbed by inflammatory action.
3rd When the tumour is discoloured, and evidently dying, and the distal parts of the limb are cold, oedematous, and threatening to become gangrenous.

Varicose Aneurism is seldom if ever of spontaneous origin. It is a false aneurism communicating with the vein. The surrounding veins
are congested on account of the obstruction produced by the meeting of the two currents. A peculiar sound is produced very like the purring of a cat, or the noise made by a large whale going round.

There is no tendency to the separation of fibrine within the sac. The treatment is the same as for false aneurism.

**Arteriovenous Varix**

In this case the wound of the vein is united with that of the artery. There is a great want of power in the limbs beyond the limitation of the disease. The symptoms are seen and the same as in varicose aneurism, but more strongly marked. It may be treated by palliative measures unless the patient wishes a radical cure.

When the operation is performed the vein is to be separated from the artery and the latter tied.

**False Aneurism**

This is of very rare occurrence. The
Bone is hollowed out into a cavity, containing fluid and coagulated blood. It is invariably found in the head of the Tibia. The treatment generally necessary is amputation above the diseased bone.

George Florence