SOME REMARKS
ON
WOUNDED ARTERIES, SECONDARY
HÆMORRHAGE,
AND
FALSE ANEURISMS.

By ROBERT LISTON, F.R.S.,
SURGEON TO UNIVERSITY COLLEGE HOSPITAL, AND VICE-PRESIDENT OF THE
SOCIETY.

Received April 6th—Read April 14th, 1846.

THE subject of wounds of arteries, with the consequences of such wounds, immediate and remote, has possessed, and always must possess, great interest in the eyes of the surgical practitioner. My impression, until very lately, was, that no subject had been better handled, or was better understood by surgeons generally, and that all writers were pretty well agreed as to the rules which ought to guide the practice in such cases. As, however, the propriety of the treatment adopted in the following case has been called in question, I propose to relate very shortly its leading features, and to support the line of practice pursued, by a reference to, and relation of, some similar instances.

Mr. S., ætat. 28, an exceedingly corpulent person, who had, it appears, lived very freely for a series of years, was wounded on the 20th of May 1845, by a pistol bullet. It entered the upper and outer part of the right thigh, a little above, and in front of, the trochanter major, and passed out in the middle of the fold of the left groin, thus traversing the course of the femoral vessels. The flow of blood, more especially from the wound on the right side, was described to have been most impetuous and profuse, being thrown in jets to a considerable distance—it was said, two or

three feet. The patient was found by Mr. Jenkins, of Gosport, who was first called to his assistance, in an almost lifeless state, and he was with great difficulty recovered from the syncope and depression. The line of the ball could be distinctly traced by the discolouration and slight elevation of the skin; and a considerable swelling from extravasation of blood, soon supervened over the lower part of the abdominal parietes.

May 27, the seventh day from the receipt of the injury, the swelling in the right groin began to increase in size, and distinct pulsation was then, for the first time, perceived in it. The tumour went on increasing gradually and progressively, and it had gained much more in bulk on the 10th day, when I first saw him, than it had done on any of the preceding ones. It was of an oval form, and extended from a little within the anterior superior spinous process of the ilium, to the linea alba. It projected but slightly over Poupart's ligament upon the upper and inner part of the thigh. It was elastic, but firm, as if partly made up of coagulum and liquid blood; but it could not be at all diminished in bulk by uniform and continued pressure. Pulsation was strong and distinct in all its parts. The circular opening on the right hip was filled with a dry, depressed slough, and had a slight blush of redness around its margin. The wound in the left groin had the appearance of a jagged slit, and was partly closed by a very thin cicatrix. Near this was a swelling distinct from the other, discoloured on the surface, fluctuating indistinctly, and supposed to contain some bloody, purulent fluid. The patient's countenance was blanched and waxy, and his pulse quick and feeble. He had, in short, all the appearance of a person who had lost a great quantity of blood.

The nature of the case was very apparent. A large false aneurism, not well bounded, and rapidly increasing over the abdominal parietes in the iliac region, and arising from a wound of the femoral artery, or of some branch, divided close to its origin, had to be arrested in its progress,

otherwise the patient must be left exposed to the risk of perishing suddenly, and at no distant period.

After consultations on the evening of the 30th and morning of the 31st, with Drs. Mortimer and Stewart, Messrs. Jenkins, Sampson, and Potter, the external iliac artery was tied, with the loss of not more than a table-spoonful of blood, and with the immediate effect of arresting the pulsation, and of removing in a great measure the tension of the tumour. The corresponding limb, which had been somewhat swollen, was found, on the day after the operation, diminished in bulk, and of its natural temperature.

Symptoms of peritonitis supervened this same evening, and on the following afternoon the patient sunk.

The *post-mortem* examination by Dr. Allan, of Haslar, is here subjoined.

Examination of the body of the late J. A. S., 18 hours after death.—Body very fat and muscular; swelling and ecchymosis of the right thigh, particularly at the upper part, and in the right iliac region; also swelling and ecchymosis of the scrotum, chiefly in the right side, with a general tumefaction of the abdominal parietes below the umbilicus.

A wound, into which the little finger could be pressed, was on the upper and outer aspect of the right thigh, about three inches below the crest of the ilium, and about an inch nearer the mesial line than the great trochanter; and, on the left side, another smaller wound, situated about the external aperture of the left spermatic canal.

The first-mentioned wound was open; the lips of the latter were partially adherent. There was also a long, oblique incision in the usual situation of the operation for tying the external iliac artery.

The course of the bullet was traced from the outside, through a dense layer of fat, about two inches in thickness on an average. It had divided one of the superficial branches of the femoral artery, about half an inch below Poupart's ligament, and about an inch from the main body of the

femoral artery, which had caused a false aneurism. The sac contained about three ounces of blood. Blood was also effused into the cellular structure of the scrotum, and downwards beneath the sartorius muscle.

The bullet had passed through the cellular tissue, across the pubes, and emerged about the situation of the external spermatic ring, without having divided the cord on either side, and being quite superficial to the bladder.

No other artery appeared to have been wounded.

When the parietes of the abdomen were reflected, a considerable quantity of sero-purulent fluid was found in the abdominal cavity, and on different parts of the large and small intestines, patches of acute inflammation were observed, particularly on the ascending arch of the colon.

The peritoneum adjoining the wound of the operation was inflamed, and approaching to gangrene; it had not been injured by the knife during the operation. The intestines were unusually large, and distended with flatus. The other abdominal viscera were healthy, but loaded to an extraordinary degree with fat. The ligature had been properly applied to the external iliac artery. The vein was not injured. The surface of the wound and the cellular tissue in the neighbourhood of the artery were sloughy.

The viscera in the thorax were healthy, with the exception of almost general adhesion of the right lung to the costal pleura; and on cutting into that viscus, it was found to be full of dark blood. There was some enlargement of the right limb, but apparently no mortification.

The femoral artery was pervious. The course of the ball was through a bed of fat, fourteen inches in length and three inches in depth, over the pubes, and no muscular substance was injured.

The blood in the aneurismal sac was firmly coagulated, and there was no mark of recent oozing from the injured artery.

N.B.—On removing the coagulum from the aneurismal sac, the divided mouth of the artery was exposed in that part of the wound from which the sac had originated.

The ball had passed immediately over and along the course of the artery, for about half an inch before it divided it. It was given off from the fore part of the femoral artery, about half an inch below Poupart's ligament, and passed in the direction of the pubes. Between its origin and division there was not more than an inch of extent. I raised it with the forceps from its attachment in the bottom of the wound, from the part where it was divided, to where it passed through the fascia, down to the femoral artery; and although it was not actually detached, it would not have borne a ligature.

JAMES ALLAN, M.D.,
Deputy Inspector, Haslar Hospital.

We, having been present at the *post-mortem* examination of the body of the above J. A. S., concur in this report.

JOHN MORTIMER, D.I.H.
J. STEWART, (A.) M.D.,
Surgeon, R.N.

Portsmouth, June 3, 1845.

That a vessel of this class should have bled so furiously in the first instance, could not have been anticipated. Having done so, one can so far understand the active pulsation and rapid extension of the tumour. It was, of course, quite impossible in this case to determine whence the blood flowed into the aneurismal cavity. The principal vessel going to the limb might, for what we knew, have been wounded, or some considerable branch, as the epigastric, the external circumflex, the external pudic, or perhaps a considerable common trunk sending off the superficial epigastric, and branches to the inguinal glands, near their origins from the iliac, or common femoral. The division of even a small branch close to the principal vessel, it is well known, pours out blood furiously, as much so, in fact, as if an opening in the coats of the artery itself were, so to say, punched out, corresponding in size to the area of the branch. "The division of an artery of the size of the last referred to (small muscular branches, which spring from most arteries at irregular in-

tervals), at a distance from the source from which it springs, is of little importance. It contracts, and soon ceases to bleed. But when it is divided close to the trunk, blood issues from it, as it would if an opening, equal in size to the calibre of the little branch, were made in the trunk itself." (Quain's Anatomy, 5th Edit. p. 595.) This I have actually experienced in operating on the femoral artery in the groin, as will appear by and by.

"Any of these inguinal branches being cut near their origin, may bleed a patient (already perhaps reduced, as by mercury,) to death." (Engravings of the Arteries by Sir C. Bell, p. 45).

No one will pretend to say that this patient was not in the most imminent danger of losing his life from day to day, nay, from hour to hour. Let us see what Mr. John Bell, one of the best writers, and to this day the highest authority, on the subject, says to it:—

"But the secondary hæmorrhage is still more to be feared, as the hidden danger is always greater than the open danger; for, as I have said, the patient lying easily, even for ten days, is no security that in the end he shall not bleed to death. Every circumstance concurs to lull us into a fatal security. The patient is easy, and tolerably free from pain; there is no fever; there has been no bleeding: even at the first the wound was scarcely stained with blood. On the eighth day, the eschar of the mortified and bruised parts begins to loosen; on the ninth or tenth day, the sloughs begin to fall, and if the partial gangrene has touched the coats of a great artery, the sloughing of these coats leaves a breach in its side; the blood bursts out impetuously, and it is not that the patient may die of a sort of slow bleeding betwixt night and morning, but he dies in a moment." But even without external hæmorrhage, patients have been known to perish in consequence of the sac giving way, and effusion occurring to some extent into the cellular tissue. I had under my care some years ago, a man about sixty, weak and worn out by continued suffering, on account of an aneurism in the right

axilla, of considerable size. The condition of his circulating system, diseased heart, and vessels, precluded any attempt at a cure by ligature of the subclavian. He was suddenly, whilst in bed, attacked by faintness, and a feeling of sinking. Rapid and great swelling was discovered in the side corresponding to the aneurism, and in about an hour and a half he died. On dissection, the sac, dense and well formed, not, as in the case that forms the subject of this paper, soft, ragged, and lacerable, was found to have given way, and there were, at least, a couple of pounds of blood found in mass, or extravasated in the cellular tissue, under the latissimus dorsi, and down to the crest of the ilium.

In the case of Mr. S., some active measure was evidently required, in order to arrest the threatened danger; cold could not here be expected to answer any good purpose: it had, in fact, been tried without the least benefit. Pressure could not be applied between the heart and the open vessel—applied to the tumour, it would have vastly increased the danger. It might, at first, have given rise to a diffusion of the swelling; but if continued, even for some hours, the already discoloured skin would inevitably have perished; and then, instead of two sloughy wounds, ready at any time to burst out, and threatening to form a communication with this bag of blood, we should have had a third superadded. Could not the sac be cut into, if an operation was really the only resource, and unavoidable; and the wounded vessel, whatever it turned out to be, secured by ligature or ligatures? I, for one, knowing well the circumstances, should not, if it had been proposed, have countenanced it by my presence. Patients who have previously lost a great quantity of blood, are often sunk and lost by the sudden effusion of even a very small quantity. Ranby, the old and experienced army surgeon, tells us that he has seen a patient perish from secondary hæmorrhage, having lost not more than 12 ounces of blood: and every surgeon who has witnessed practice must be sensible of the truth of this remark. Many patients have died instantly on bloody collections being opened, and even in situations where

the assistants had it so far in their power to weaken or arrest the flow of blood by pressure on the trunk of the vessel betwixt the opening into it and the heart.

A man, æt. 35, was wounded in the neck with a penknife. The external carotid artery was supposed to be implicated. The common carotid was tied. Everything went on well for about three weeks. The wound healed all to the granulation through which the ligature had protruded; oozing of blood took place from this point, and gradually increased. A "thrombus," the size of a walnut, formed in the neighbourhood of the original wound. This was opened, and a clot turned out; there was a smart gush of blood, and death immediately ensued.

Two young men were "larking" in an agency office; one of them drew a sabre, and struck his companion, by an awkward and unintentional thrust, on the inside of the thigh. There was a sudden and most profuse gush of florid blood, showing that a large vessel had been opened. The patient was saved for the time by syncope supervening. The thigh was bandaged up; next day, an apothecary, assisted by a mere anatomist, not a very practical one, proceeded to look for and tie the wounded artery. The thigh was much swollen; a large collection of blood having filled the subfascial cellular tissue. This bag of blood was cut into. The operator and his attendants were instantly covered with its contents. The lad was dead. The danger of opening a false aneurism, with the view of searching for the wounded vessel, must, of course, be very much enhanced, when the tumour is so placed that there is no possibility whatever of making pressure on the trunk of the artery on the proximal side of the opening into it, or of the origin of any branch wounded close to where it is given off.

In the case of Mr. S., the principle of tying the artery, where wounded, could not possibly be carried out with any propriety. It was not known what vessel was really implicated, and this could not be known during life. If the tumour had been lower down, somewhere in the thigh, the question

of cutting into the sac might have been entertained; but even then, it is to be doubted whether or not the patient, in his reduced state, would not have had as good a chance by the ligature of the iliac as by the tying of the femoral, or any of its branches where divided.

As it was, the cyst could not have been opened without great loss of blood, however dexterously and boldly it might have been set about. Even knowing, as we do now, from whence the blood came, it was not likely that the application of a ligature to the branch would have permanently arrested the bleeding. Indeed, it is distinctly stated by Dr. Allan that the vessel would not have held a ligature. It was not unlikely that, even in the first instance, or, perhaps, at a later period, and in consequence of secondary bleeding, it might have been necessary to tie the common femoral. Secondary bleeding from this artery, supposing that the patient yet survived, would, probably enough, have supervened. If we look at the circumstances in which this vessel is placed, the doubt as to its length and the arrangement of its branches, we cannot be over sanguine as to its permanent closure. By experience it is well ascertained that, when exposed and tied, it has very often been the source of alarming secondary hæmorrhage. After all, the ligature of the iliac was more than likely to be required in the end, always supposing that a patient so treated lived through all his various trials.

This mode of proceeding in the particular case, was thus looked upon as in every way perilous and inadvisable. The placing of a ligature upon the external iliac, so as to favour the coagulation of the contents of the tumour and the permanent closure of the wounded vessel, seemed to afford the only chance of safety. It may be asked, Is there any thing to bear a surgeon out in adopting this practice? Can any cases be brought forward to show that vessels bleeding outwardly, or pouring their contents into the tissues of a limb or region, have ever been put in a way of being permanently closed, in consequence of the flow of blood being intercepted and weakened for a time, by the application of a ligature

upon the principal arterial trunk? First of all, then, let us look to what happens, in some of those exceedingly perplexing cases of wounds in the palm of the hand, followed by secondary hæmorrhage, or false aneurism. The great difficulty of securing those vessels, even in recent solutions of continuity, is acknowledged. But when, perhaps at the end of eight or ten days, blood bursts out furiously from the wound from time to time, the young surgeon is often puzzled what to do. The bleeding has sometimes been stopped by well-applied pressure; the wound being, perhaps, somewhat enlarged, the clots cleared out, and compresses applied accurately to the bottom of the cavity. Sometimes, again, the bleeding has seemed rather to be provoked by compression and by tight bandaging. It has ceased when the hand has been freed from all apparatus, the wound perhaps dilated, and cold applied. Cases of this kind used to be related by Mr. Abernethy, in his Surgical Lectures. The bleeding, it is true, may often be arrested for a time by tight binding; but the process for the permanent closure of the wounded vessel cannot be expected to go on favourably, if at all, under such a degree of pressure as is required to stay the flow. Under many circumstances, as when the member is violently inflamed and swollen, and the tissues infiltrated with blood, with serosity and purulent secretion, pressure cannot be borne, and may be followed by the most disastrous consequences. What is then to be done? The ligature of the radial and ulnar arteries, separately or together, near the wrist, will seldom serve any good end. This practice has been many times tried, and failed in a most marked manner. The ligature of the brachial and light dressing of the wound has been found to answer admirably in such cases.

Thomas Sutherland was admitted into the Royal Infirmary, Edinburgh, January 6, 1827, on account of a wound by a piece of a broken wine bottle. The radial artery was implicated where it passes betwixt the metacarpal bones of the thumb and forefinger, to join the deep palmar arch. The vessel was tied on the proximal side of the opening, and it

being found impossible to discover the other end, a piece of sponge was introduced into the wound. On the 11th, bleeding occurred from the part of the vessel which had been tied. The wound was enlarged, and the artery tied above and below. The original wound then took to bleeding. It bled repeatedly, on the 14th, and again on the 15th. The hand had become swollen, and a quantity of matter had collected. An attempt was made, by cutting up the original wound, to expose and tie the bleeding vessel; but on account of the sloughy state of the parts the ligature would not keep its hold. The humeral was then tied by Sir George Ballingall, and there was no further trouble; the patient made a rapid recovery.

A man had his thumb all but blown away by the explosion of an old powder-flask made of copper. He lost but little blood at the time. He was admitted into the University College Hospital, whilst Mr. Potter held the office of house-surgeon, some days after the infliction of the injury, with his hand violently inflamed and swollen. There was a deep ragged laceration between the thumb and forefinger, which seemed to extend to the carpal end of the first metacarpal bone. The wound was covered with foul and fetid sloughs, and all around was blackened. There was another and more extensive laceration, but superficial, extending from near the middle of the palm, round the root of the forefinger to the dorsum of the hand. There was a great deal of constitutional disturbance. All seemed to promise well. After a few days the fever abated, and the wound became clean and began to granulate. Ten days after the patient's admission, however, an alarming arterial bleeding took place, to the extent of sixteen or eighteen ounces. This happened on the 23rd of the month. On the 27th, the patient was seized with sudden and intense pain in the injured part, and on exposing it, a pulsating tumour, round and elastic, was discovered, betwixt the metacarpal bone of the thumb and that of the forefinger. The pulsation was abated and the pain relieved by pressure on the radial. I considered it, however, more safe

and certain to put a ligature on the brachial at once, than upon this vessel. The pulsation ceased instantly and entirely, and the pain was relieved. The ulcer bled freely during the operation, but the bleeding was immediately arrested upon the ligature being tied, and all ended most satisfactorily.

William Grant was admitted into the Royal Infirmary of Edinburgh on the 4th of May 1827, on account of gun-shot wound of the hand, injuring the ball of the thumb and the parts on the posterior surface of the metacarpus. A profuse hæmorrhage occurred on the 15th, from the radial artery, where it passes between the metacarpal bones of the thumb and forefinger. This hæmorrhage recurred, in spite of every effort to restrain it. The brachial artery was tied by my late colleague, Dr. John Campbell. On the 17th day after the vessel was tied, profuse bleeding occurred from the wound in the upper arm, made in the operation, as was supposed from the premature disturbance of the ligature, by a sudden start of the patient during his sleep. Another ligature was passed under the artery about two inches above the former, and from this time the cure was progressive. There was no return of bleeding from the wound of the hand.

John Carter was brought to the University College Hospital, April 10th, with his hand shattered by the bursting of a gun; the little finger was removed, and parts of the ring and second fingers. Besides the injury to the fingers, there was a lacerated wound of the palm, extending from the cleft between the middle and ring fingers, two-thirds across the palm. The wound was not deep: the palmar fascia not appearing to be much injured, the edges of the wound were brought together by a single suture and simply dressed. The progress of the wound was rapid, till on the 10th day (April 21st), when the wound of the palm had filled up and was beginning to cicatrize, a pulsating tumour, about the size and shape of an almond, and extending across the wound, was perceived at its upper part: the pulsation was stronger than the pulse at the wrist, and superficial, and the long diameter was in the direction of the wound. Pressure on the

ulnar artery almost entirely controlled the pulsation; pressure on the radial had very slight effect on it, but pressure on both together, or on the brachial, entirely commanded it. The palm of the hand was padded with lint, and the limb being bandaged, two ring tourniquets were applied to the humeral artery, the one being tightened when the patient complained of pain from the pressure of the other: an interval was left in the bandages opposite the tumour, to enable the surgeon to acquaint himself with the state of the pulsation. After a day or two the alternate tightening of the tourniquets was left to the patient.

May 14.—The fingers, notwithstanding the pressure on the artery, are healing fast; the tourniquets have throughout well controlled the pulsation in the aneurism; to-day, on removing them, scarcely any pulsation was perceptible in it.

18th.—To-day, on removing the pressure from the artery, no pulsation could be perceived in the tumour, but the beating returned feebly when it had been off a little time. The tourniquets were kept on till the 29th, when, on removing them, no pulsation was felt in the aneurism; the circulation in the brachial was fully re-established on taking off pressure. The pulsation, however, returned feebly in a few hours, and in three days was nearly as strong as ever. The patient had got tired, by this time, of the pressure, and would not keep it up sufficiently. On June the 8th, Mr. Liston tied the brachial artery, which immediately stopped the aneurismal pulsation and that of the radial and ulnar arteries. No pulsation has been (June 30th) perceived in the site of the tumour since the operation, though the pulsation has returned pretty fully in the arteries of the forearm and hand; the wound soon healed, with the exception of the part close to the ligature, which has not yet come away. The ligature separated a few days after the last report. The wound healed speedily, and the patient left the hospital quite well.

Mr. Guthrie, in cases such as those above related, recommends that a clean and decided incision should be made in the line of the wound down to the metacarpal bone, and that

this should, if necessary, be cut out with the finger, so as to obtain space to see the wounded vessel. "The hand is only to be amputated as a last resource."

The practice of tying the brachial artery, on account of secondary hæmorrhage, or false aneurism in the palm of the hand, though ascertained to answer perfectly in many instances, cannot be expected to be uniformly successful. I am quite ready to admit, that "the ligature of an artery at a distance from a wound in its coats, will not always secure the patient from hæmorrhage; for the blood will either flow from the lower end of the artery, or from the upper, into which it will enter, through branches which open into the trunk between the ligature and the wound." In the neck and forearm, the arterial trunks of which communicate so freely by the circles and arches, it might, *à priori*, be supposed very likely to fail; and so it is found to be the case in practice.

Mr. Hodgson, in his excellent work on "Diseases of Arteries and Veins," relates a case furnished him by the late Mr. Earle, in which, after ligature of the brachial, hæmorrhage occurred from the sac of a false aneurism of the radial, and it was ultimately necessary to tie this vessel also.

A case, in many respects similar, occurred in my practice many years ago, in which the ulnar artery had been wounded in the upper part of the forearm by a small chisel. A circumscribed false aneurism of small size, which had formed, was compressed along with the lower part of the limb, whilst pressure was also made in the course of the brachial; but the surface of the tumour soon became abraded, and the cicatrix threatened to give way. The brachial artery was tied. About 12 days afterwards, profuse bleeding took place from the original wound, a small slough having separated; and then the practice which probably should have been at first followed, was successfully adopted. An incision was made along the course of the ulnar artery, through the bleeding wound, and both ends of the bleeding vessel tied. A cure soon followed.

Again, in secondary hæmorrhage from stumps, that bleeding which takes place about the 8th or 10th day, or even as

late as from the 20th to the 30th, in consequence of an unhealthy condition of the wound, induced by an unfavourable state of the atmosphere, the exposure of the patient to various vapours and miasms, or from too free indulgence in stimulating food and liquors, the surgeon is called upon to afford prompt assistance. When the bleeding occurs at an early period, say within a few days of the amputation, the opening up of the wound, the turning out of the coagulated blood, gentle support, and elevation of the stump, with the constant application of cold, may have the desired effect; but these means often fail, and these are cases in which there can be but little use in attempting to find and tie the opened vessels. Surgeons are pretty well agreed, I am led to believe, that the ligature of the trunk supplying the limb, and above any branches that may possibly reach the stump, is the proper practice to be pursued. I have had occasion to perform this operation pretty often, principally on hospital patients, and with uniform success. In what, then, do these cases differ from false aneurism, fed by a vessel large or small, as may be? In the one case the blood is confined for a time in a tender bag, ready to burst out sooner or later. In the other, the blood is poured out without restraint, on every hæmorrhagic effort, whenever the vessels get full and the circulation is any how excited. There is no recurrent circulation, it is true; but we may have bleeding from several open mouths at one and the same time, and the trunk of the vessel below the deligated point is, of course, freely supplied through the anastomosing branches.

A case is recorded in the Society's Transactions, by Mr. Potter, which bears somewhat on the question at issue. The patient had amputation of the thigh performed on account of a diseased leg (intractable ulceration, with solid œdema), which had long been a burden to him. On the 8th day, bleeding commenced from the stump; on the 9th, the common femoral was exposed and tied, immediately before the ligament of Poupert. It was in this instance that a small artery was wounded, close to the trunk, and so impetuous and rapid

was the bleeding, that it covered the by-standers, and induced most of them to believe that the trunk itself had been cut into. The branch was secured, and the operation proceeded with. On the 14th day, the ligature separated from the trunk of the vessel. Sixteen days afterwards, bleeding took place from the wound in the groin, and the external iliac was forthwith tied successfully.

A very interesting case, treated with great judgment and skill by my friend Dr. Paul, of Elgin, may also be added here. The patient, a young man, had his thigh amputated secondarily, in consequence of bad compound fracture of the bones of the leg, extensive suppuration, and hæmorrhage, on the 9th of August 1842. On the 15th of the same month, alarming bleeding took place from the stump. The common femoral was cut down upon and tied. On the 30th, bleeding took place from the deligated part of this vessel and recurred on the next day. The external iliac was then tied. There was no further hæmorrhage, and the patient ultimately recovered.

A few cases may be added in which secondary hæmorrhage followed wounds and ulcerations of arterial trunks and branches, and others in which false aneurisms formed, and where the practice of securing the trunk at some distance by impeding for a time the flow of blood to the part, gave opportunity for the curative process of nature to close the wounded vessel permanently, so that the lives of the patients were thus preserved.

H. S., ætat. 14, was admitted into the University College Hospital on account of a wound of the back of the leg, caused by falling through a skylight, which he was engaged in cleaning. The gastrocnemius, soleus, and flexor communis digitorum were divided, and it was thought improbable that the posterior tibial artery should have escaped. He lost, it was said, about two quarts of blood. Two large vessels were tied, the wound was dressed, and went on favourably; but on the 13th a profuse hæmorrhage occurred, "evidently from the posterior tibial artery," and was arrested

by pressure after 14 ounces had been lost. Again, on the 15th, the wound bled more furiously than before; the artery was cut down upon and tied. On the 25th, another hæmorrhage occurred to 12 ounces: and again, on the 26th, the same quantity was lost. The wound was then extended upwards, and the posterior tibial artery again secured. Still, on the 27th, bleeding took place, apparently from the lower part of the wound. Mr. Cooper then tied the popliteal, with the effect of permanently arresting the bleeding, and the patient made a good, though slow, recovery.

In the year 1814, my colleague, Mr. Cooper, tied the superficial femoral, on account of profuse hæmorrhage from a gun-shot wound in the popliteal space, ten days after its infliction, and deposition of lymph in the vessel at the wounded part. "But no doubt it was the diminution of the impulse of the circulation by the ligature of the femoral artery, which enabled nature to complete the obliteration of the wounded part of the vessel."

A Student of Medicine, ætat. 24, had suffered from eruptions on his legs, whilst pursuing his studies closely in the dissecting-room, and at the time a good deal out of health. He thought that he had scratched the affected part of the right leg, which itched much near the ankle, and introduced into it some cadaveric poison. The lymphatics of the limb and the glands in the corresponding groin became inflamed, and swelled much. Matter formed, and I opened, after a time, an abscess about four inches above the knee, and over the vastus internus muscle. A fortnight after this, the pus having been occasionally slightly tinged with blood, arterial hæmorrhage took place suddenly to the extent of two pints, whilst the patient was on the night-chair. Pressure was made on the femoral; syncope took place, and the bleeding ceased. Two other bleedings occurred, and the patient became so much exhausted that any further loss of blood could not have been borne without risk of sudden death. The superficial femoral was secured at the usual place: and the ligature separated on the 19th day. There was no further bleeding:

—recovery was slow; but the patient now enjoys perfect health.

About the 12th Sept. 1827, some carcinomatous glands were removed from a chimney-sweeper's groin—not a very wise or warrantable proceeding. The wound looked tolerably well for some time, but it soon changed its character. On the 18th December, after degeneration of the sore, and extension, both in width and depth, had taken place, the discharge having been thin, and a good deal tinged with blood, alarming hæmorrhage occurred: this returned several times during the day. The external iliac was with some difficulty, owing to the condensation of the tissues about the groin, exposed, and included in a ligature. This came away on the 11th day, and on the 30th January the wound was nearly healed. Bleeding, however, occurred from it, on the patient trying to get out of bed. This recurred more than once, and the blood was supposed to proceed from the obturator, opened from an extension of the malignant ulceration. Its flow was arrested by pressure with sponge. He was received into a workhouse, and lived six months.

The external iliac was obliterated, and its coats converted into a ligamentous cord, from the point at which it had been tied, immediately above the origin of the epigastric, up to its junction with the internal iliac. On examining the ulcer, there was no trace of the common femoral artery for fully three inches, including the origin of the profunda; and the ulcerated extremities were closed by firm coagula. The formation of these coagula, no doubt, was attributable to the force of the circulation being diminished by the obliteration of the vessel above. The removal of the glands was undertaken by a practitioner long since dead. The chimney-sweeper's life, no doubt, was much prolonged by the ligature of the iliac, performed by my friend Sir George Ballingall. It was a distressing case to be concerned in; but under the circumstances, there was no other course to be pursued.

The late Dr. Hennen, in his excellent work on military

surgery, relates a very interesting case, in which, through sloughing bubo of the groin, the external pudic was supposed to have been opened: most profuse bleeding took place; it recurred in spite of pressure, actual cautery, &c. &c. The femoral artery itself was, it is said, found, on a close examination, after removal of the clots, to have given way. The external iliac was tied, no further bleeding took place, mortification set in, the limb was amputated pretty high up; but the patient recovered.

Other cases of the kind might, I have no doubt, be discovered, and brought forward, in corroboration of the propriety of this line of practice.

In the 7th vol. of the Transactions of this Society, Mr. Collier relates a case of false aneurism of the groin following a wound of the femoral, or some branch of that vessel, by a musket-ball. There was considerable bleeding at the time of the wound, but it healed without any thing remarkable taking place. "Fearing lest the pulsation, or any loss of health, might occasion the cicatrix to ulcerate, Mr. C. determined not to delay securing the external iliac artery, an operation which he judged to be requisite in order to save life, and to be urgently called for from the visible enlargement of the tumour." The patient died from mortification of the limb, and, on dissection, "a small communication was found between the femoral artery and vein, at the side of the tumour, about an inch and a half below the origin of the profunda."

In the 11th vol. of the same Transactions, Mr. Norman, of Bath, has given some exceedingly interesting cases of aneurism, in which the external iliac and femoral were tied. One of them bears on the subject in hand.

A boy of 14 years was admitted into the hospital on the 28th August 1817. A month before, he had received a punctured wound in the upper and outer part of the thigh, from which he almost bled to death. Blood was discharged for two days, but not to such an extent as to excite alarm. On the third day it bled again, and this was repeated several

times. By and by all hæmorrhage ceased for more than ten days. Exactly a month from the date of the injury, a very profuse bleeding took place, which reduced the poor boy very much : and on the following morning, an attempt was made to secure the wounded vessel. An incision of seven inches was made through the wounded part on the outside of the limb, a large cavity amongst the muscles was opened, and the coagulum turned out from the bottom of it ; the blood issued out furiously and abundantly, but the bleeding vessel could nowhere be discovered. Mr. Norman, unwilling to hazard any further loss of blood in attempts to search for the wounded part of the vessel, tied the external iliac, the vessel being meanwhile compressed by an assistant's fingers in the wound. The hæmorrhage was moderated, but not entirely checked. A second ligature was passed round the femoral artery, two inches below Poupart's ligament, and this had the desired effect of stopping the flow of blood entirely ; only 4 ounces were lost, yet the boy was so exhausted that his extremities were cold, and no pulse could be felt ; his breathing being almost suspended. Mortification of the foot took place, but the patient eventually recovered, and left the hospital at the end of November.

Mr. Norman is of opinion that the blood which flowed after the application of the first ligature, reached the femoral by the epigastric and circumflexa ilii, and that the original wound was below the point at which the second ligature was placed. In the catalogue of the Museum of University College, are notices of two cases in point.

“ The external iliac artery tied for ulceration of a great portion of the femoral artery.

“ Josiah Wilcock, a young seaman aged 22, was admitted on board the Hospital Ship “ Grampus,” with a bubo in the left groin. When he had been in the hospital three weeks, his general health became much affected, and there was violent inflammation of the bubo. The inflammation became extensive, and deep sinuses formed in various directions, particularly

among the abdominal muscles, and in the course of the femoral artery in the thigh. After 15 weeks of great suffering, the ulceration assumed a phagedenic character. In the course of one day, a pulsating tumour, of the size of a pigeon's egg, formed, an inch beneath Poupart's ligament over the situation of the artery. Next day the tumour burst, and before I could reach him he had lost about two pints of arterial blood. I immediately tied the external iliac artery, which was rendered somewhat formidable, from the mass of disease existing in that portion of the abdominal muscles through which I had to make my incision. On the tenth day the ligature came away. The discharge from the wound till within three days from his death was quite healthy. The foot and knee mortified, and he died on the twentieth day from the operation.

“JAMES THORBURN, Assistant Surgeon.”

“*The external iliac artery tied.*”

“An old woman had a swelling in the groin, which was opened by a lancet, and hæmorrhage to an alarming degree immediately took place. Compression of the artery at the groin being made, the hæmorrhage ceased. When the surgeon arrived, he found that florid blood flowed copiously from the puncture whenever the assistant's finger was raised from the artery of the groin, and was completely restrained when the artery was compressed. He tied the external iliac artery, and there was no more bleeding. The ligature came away at the proper period. The outward wound did not heal—sinuses formed around it. In about three weeks the patient died of peritonitis. Upon injecting from the abdominal aorta, the wax filled the femoral artery, and its branches below where the ligature was applied. It would appear from examining the preparation, that the hæmorrhage was owing to one of the branches of the femoral artery being opened either by the lancet, or its coats destroyed by the peculiar nature of the tumour.”—*Descriptive Catalogue of the Museum of Anatomy of University College, London*, page 449 and 450.

In conclusion, I must beg leave to refer to one more case. It is to be found in the works of a well-known army surgeon. A man 30 years of age, was wounded on the glorious 18th of June, by a musket-ball, which entered the left groin a little below Poupart's ligament, and passed through the inside of the thigh.

"On the 29th, (mark, the 10th day from the injury,) the slough from the anterior wound came away, and was followed by so frightful a hæmorrhage as to leave no doubt whence it proceeded, nor (from the wound being so high up) any alternative as to the means to be adopted for stopping it."

The external iliac was tied, but the patient died of fever on July 5th: there is, however, no account given of any dissection of the parts.

"In this case the necessity of the operation is evident, and as far as it went, also, its success. Not a drop of blood was lost after it."—So says Mr. Guthrie, who, it is to be presumed, conducted the treatment of the patient. We are here left to conjecture what vessel was really wounded. It is said "that there could be no doubt as to whence the hæmorrhage proceeded;" but it may have been from a branch, as likely as from the trunk, and those who have attended to the description of the hæmorrhage in the case of Mr. S., to its impetuosity, and amount, will bear me out in this assertion. The external pudic, or external epigastric, or one of the circumflex arteries, may have been here cut off close to their origin, just as likely as that the femoral was wounded.

I have thus endeavoured to show—

1st. That the case of Mr. S. was one of great and immediate danger.

2ndly. That some decisive step required to be taken, and that without a day's delay, in order to avert the danger that impended over him.

3rdly. That very great risk would have been incurred in searching for and attempting to put a ligature upon the wounded part of the vessel.

4thly. That there is ample authority for adopting the

step which was had recourse to in the case. Ligature of the external iliac was undertaken, in order to ward off the expected fatal termination, through a sudden escape of arterial blood.

And it may here be remarked, that we were not apprehensive of a remote danger, or labouring under a vague impression that something untoward might arise; the danger was manifest. An artery had begun to pour out its contents impetuously, and the blood was only prevented from escaping externally by rotten tissues, that were about to separate, and could not by any possibility resist the impulse many hours longer. It must also be borne in mind, in considering the bearings of this case, that it might have been absolutely impossible to effect even the operation of tying the iliac, had the effusion extended ever so little further. No one will pretend to say that the operation of tying the iliac artery of itself is not attended with danger to life. But the dangers of mortification, secondary bleeding, &c., likely to arise from the operation, were considered as weighing but lightly in the scale against those impending from the effects of the pistol-shot. Mr. S. died, it has been seen, from the effects of inflammation of the peritoneal cavity. But this was scarcely taken into account at all, in consulting on the case. When we look at the result of the cases published in this country, from the time that Mr. Abernethy first tied the vessel, about fifty years ago, to the present period, it will be seen that we were justified in not laying very great stress on this source of danger. It appears that out of 45 cases recorded, (and collected by Mr. Crisp, in an excellent paper on aneurism, to which was lately awarded the Jacksonian prize by the Council of the College of Surgeons,) 9, or $\frac{1}{5}$ th, died; three of those from sloughing and bursting of the sac, two from mortification of the limb, two from secondary hæmorrhage, one from disease of the chest, and one from sinking of the vital powers. Many unsuccessful cases have no doubt been left unpublished, and some in which the patients suffered from inflammation of the peritoneal membrane might be adduced.

In the case of Mr. S., the sac no doubt might have sloughed, secondary bleeding might have occurred on the separation of the ligature, however carefully applied. But there was nothing to prevent the collateral circulation from being carried on freely, and nothing connected with the wound, or consequent aneurismal swelling, to prevent the free return of blood by the veins. In the opinion of those concerned, the step most likely to avert danger, and prolong the patient's life, was adopted; the only step, it has been shown, that could have possibly been resorted to with propriety or safety.