

this operation, so trifling in appearance, but so important in reality, the patient looked up, and said quite distinctly, "What is that you have done which has made so great a difference in my feelings?" At the same time the pulse returned at the wrist, and from this moment he recovered without any further unfavourable symptoms. After a few days sloughs came away, probably of muscle, cellular membrane and peritoneum, in a confused mass; and with them a gall-stone of moderate size—explaining, to a certain extent, at least, the origin of the disease.

The cases in which you will most frequently have occasion to resort to the employment of scarifications are those of diffuse cellular inflammation of the extremities, whether it be phlegmonous or erysipelatous, and those of carbuncle. But there is another class of cases, which occur after injuries, and often after slight injuries of the scalp, in which the same treatment will be required; to which, before I conclude this present lecture, I am tempted to draw your attention. *First*, because they will serve to illustrate the observations which I have already made; and *secondly*, because the disease is one with which you ought to be made acquainted, but which, as far as I know, has not been distinctly described by surgical writers. Here, as in cases of erysipelas of the skin, there is a rigor followed by an attack of fever preceding the local symptoms. The latter show themselves in the form of pain in the neighbourhood of the wound or contusion, and an œdematous swelling of the scalp, without any redness of the skin. The swelling pits on pressure. It spreads over the whole scalp to the forehead, and sometimes over the whole face, the skin still retaining its natural colour, or even appearing paler than natural. The progress of the swelling is accompanied by pain in the head, and a continuance of febrile symptoms. In some cases, the disease, after having continued for ten or twelve, or perhaps fourteen days, begins to subside; the serum which caused the œdematous swelling being gradually absorbed without any further mischief. In other cases suppuration takes place underneath the scalp, with extensive sloughing of the cellular membrane, and this is followed by sloughing not only of the scalp above, but of the pericranium underneath. I have known the latter destroyed to such an extent as to lay bare a large portion of the bone of the cranium. If you would prevent all this great mischief, you must by one method or another relieve the tension caused by the œdematous effusion into the cellular membrane. Simple acupunctures are often sufficient for this purpose, provided that they are repeated once or twice daily for several successive days. Where a sufficient quantity of the serum does not escape by the punctures, large openings are required, and incisions must be made through the scalp, and the subjacent textures, quite down to the cranium. These must be repeated from time to time, as the disease extends from one part of the scalp to another. The appearances observed when these incisions are made explain in some degree the seat and nature of the disease. There is a slight effusion of serum immediately underneath the scalp; but the great effusion, and that on which the tumefaction chiefly depends, is

underneath the tendon of the occipito-frontalis muscle; and here the effusion is in some instances so extensive, that I have known the tendon to be separated as much as half an inch, or even more, from the pericranium. A large quantity of serum immediately escapes on the incision being made, the tension is of course relieved, and the destruction of the parts is prevented. I suspect this disease to be a form of erysipelas, although the skin is not usually inflamed, as every now and then it assumes the character of true erysipelas as soon as it reaches the face.

Let us now suppose that mortification has taken place to a certain extent; that the progress of it is arrested; that the system survives the shock; what further local treatment is required?

Indeed, I have little faith in any. The separation of the slough is a natural process. It is usual to apply stimulating, or as they are called, digestive ointments; solution of chloride of soda; stale beer poultice, and other things of the same kind. But my own experience would lead me to believe that the process of separation will go on just as fast with the simplest treatment, such as that of a bread and water poultice, or a linseed poultice, or wet lint with a piece of oiled silk over it. The constitutional treatment at any rate is of much more importance than any topical applications. Bark may generally be given with advantage; but the discreet administration of wine and a nourishing diet is of more importance still. Of course no general rule can be laid down. You must study the existing symptoms and act accordingly.

LECTURE V.

ON MORTIFICATION. (*Continued.*)

MORTIFICATION FROM STRANGULATION OR LIGATURE.

I now call your attention to some other varieties of mortification. A ligature drawn round any part of the body, so as to intercept the communication of the great vessels and the heart, may cause that part to perish. But the effect of the ligature is not the same in all cases; and it does not always produce mortification in the same way. You apply a bandage round the arm before you bleed a patient, to make the veins of the forearm become distended, the object being merely to stop the circulation in the superficial veins. If you take it off at the end of a few minutes, the hand is at once just as it was before the ligature was applied. If you were to leave it on for twelve hours, the whole hand and forearm would become swollen, and would remain swollen for some time after the bandage was removed. The swelling in such a case arises from the congested state of the veins, and from the consequent effusion of some of the

serum of the blood into the cellular membrane. If the ligature round the arm be still tighter, so as to obstruct the circulation to a greater extent, but without arresting it altogether, the same effect is produced, namely, serous effusion, which may continue for some time after the cause which produced it is taken away. The first effect, then, of a ligature which obstructs the circulation without arresting it completely, is to produce serous infiltration of the cellular membrane, and an œdematous swelling. The different kinds of dropsy depend on the same principle. Disease in the heart, impeding the circulation through it, gives rise to anasarca of the legs, and dropsy of the pericardium and pleura. Disease of the liver produces dropsy of the peritoneum.

But let us suppose that a ligature is applied in this manner round the arm, and allowed to remain, so that the impediment to the circulation continues. A low sort of inflammation is set up, the œdematous swelling and the tension are aggravated, and this may terminate in mortification.

This is one kind of mortification from ligature. But let us suppose that the ligature is drawn tighter still: that it completely intercepts not only the venous but the arterial circulation. It is evident that the part below the ligature, being altogether deprived of that supply of scarlet blood which is necessary to the maintenance of vitality, must lose its vitality; and this, then, is another way in which a ligature produces mortification.

In the course of your practice you will meet with numerous cases illustrative of the different effects of ligatures according to the degree of constriction which they occasion. Thus, a woman has a femoral hernia. A large portion of intestine is protruded through the narrow crural ring in the act of coughing. The ligature is as tight as possible. The strangulation is complete. The arterial circulation as well as the venous is completely obstructed. If you perform the operation for strangulated hernia on such a patient, even in half an hour, you may find the intestine dead. But if (as generally happens) the degree of constriction is less, in consequence of the opening being larger, or the protruded intestine being smaller in quantity, then the venous circulation is obstructed more than the arterial; there is no mortification immediately: there is venous congestion, followed by inflammation, which may end in mortification in the course of two or three days, or, perhaps, not until after the lapse of a longer period. A man has a phimosis. He pulls back the prepuce, and the orifice becomes a stricture behind the *corona glandis*. There is venous congestion. The glans is swollen, assumes a purple colour, then becomes exceedingly inflamed, and that inflammation is followed by mortification. Again, a patient has internal piles. They protrude at the anus; the sphincter muscle acts spasmodically upon them. They cannot be pushed back through the sphincter; the return of venous blood is prevented; they swell, inflame, and, in the course of a few days, they mortify. By and by the slough drops off, and the disease is cured.

You will now understand the principle which ought to be kept in view when we use ligatures in surgical operations. You cure

internal piles by a ligature. If you draw the ligature only moderately tight, you do not kill them at once: they swell: they inflame: they may die at last, but not till after a painful and tedious process. But if the ligature be drawn as tight as possible, it stops the flow of the arterial as well as of the venous blood, and the piles die directly. This is the way in which a ligature should be applied in almost all cases of surgical operation: it should be drawn as tight as possible. In dealing with piles, or *nævi*, or tumours of the tongue, the tighter you draw the ligature the sooner the sufferings of the patient are over. If you do not draw it tight, he suffers for a very long time, and very greatly; nay, perhaps severe constitutional symptoms may ensue.

I have said that when you apply a ligature in a surgical operation, your object should be to stop the flow of arterial blood at once; and you might suppose that if the ligature was kept on for half an hour, or an hour, that would be sufficient; that the part being deprived of the flow of arterial blood for such a time it would certainly lose its vitality. But this is not exactly the case. You apply a ligature round an artery, draw it as tight as you can; it divides the middle and inner coats, but only compresses the outer coat. It makes a slough of a little piece of the latter; and when the ligature comes away at the end of ten days, or a fortnight, you find the slough in it. But if you cut off the ligature in half an hour, or an hour—an experiment which has frequently been made—there is no slough. The artery may be obliterated, or it may not, by the effusion of lymph; but the piece of the outer coat that was included in the ligature recovers itself: at least it does not come away as a slough. I once had occasion to observe the same thing illustrated on a larger scale. I had a patient with a malignant tumour of the tongue, which, according to the method suggested by Sir Everard Home, I determined to remove by ligature. I drew the double ligature as tight as I could; and when I saw the patient half an hour afterwards, the piece of tongue included in the ligature was quite livid and apparently dead. I saw him again in three or four hours, and found him suffering a great deal of pain and inconvenience. It occurred to me that the piece of the tongue had been dead for some time, and that I should, perhaps, give relief by cutting off the ligature. With some little trouble I succeeded, but, to my great annoyance, the next day I found the whole piece, which appeared to be dead, alive again. The ligature, therefore, in surgical operations, must be drawn as tight as possible, and then left on until it is separated by a natural process.

MORTIFICATION FROM PRESSURE.

Parts may be killed by pressure. The mode of death here is nearly the same as when parts are killed by ligature. The difference being simply this: the pressure is like a ligature applied to a broad surface, operating not on the arterial and venous trunks, but on all the small vessels and capillaries. Mortification from pressure is

chiefly observable when the pressure is made on parts which lie over a bone where there is no cushion of flesh between the skin and the bone. If the pressure be very tight, it may produce mortification immediately. I remember that when I was a student, a man came into the hospital with a fracture of the leg. The surgeon applied splints, and drew a bandage over them round the foot as tight as possible. The next day the man was in a great deal of pain and suffering. The bandage was removed, but it had already occasioned a broad slough of the skin over the instep. I have in other instances seen sloughs produced in the same manner, as it were instantaneously, in consequence of bandages being applied too tight.

But in the great number of cases where mortification is the result of pressure, it does not occur immediately, but after the lapse of some time; and it is not a direct but a secondary consequence of the pressure. A man, for instance, is bed-ridden; he lies on a hard mattress; he becomes very thin; the skin over the os sacrum becomes tender to the touch, it inflames, assuming a dark red colour; vesications form upon it; the inflammation goes on, and ends in mortification. Hence, though pressure may produce immediate mortification in some instances, yet in ordinary cases it does so by causing inflammation first, which inflammation, the pressure being continued, ends in the same manner.

This kind of mortification from pressure takes place under certain circumstances more readily than under others. A man is weakened by continued fever, and, from the state of debility in which he then is, pressure on the skin over the os sacrum and other projecting parts of bone will produce mortification, while it would not produce it if he were in vigour and health. After injuries of the spinal cord, mortification from pressure is very readily induced. A man has the spinal cord torn through in the middle of the back; and you find, almost before you suspect that there is any thing wrong, a great slough over the sacrum. Nay, the pressure of the mattresses against the ankles will, in such cases, produce mortification. I have known mortification to begin in the ankle within twenty-four hours after an injury of the spine; and a remarkable circumstance it seems to be, that injuries of the spinal cord should thus lessen the vital powers, so as to make the patient liable to mortification, when we consider how many circumstances there are that would lead us to doubt whether the nerves have any influence over the capillary circulation. The circulation, viewed by a microscope, in a frog's foot, goes on just the same whether the nerves are divided or not. In an experiment which I was making on poisons, I divided all the nerves in a dog's axilla; I then divided all the skin which was attached to the anterior extremity, and then the muscles and cellular membrane, so that there was an absolute want of union between the extremity and the trunk, except by means of the axillary artery and vein, which I left untouched. The animal, at the expiration of twenty-four hours, was killed; but the limb maintained its vitality perfectly all the time. In spite, however, of this and of other circumstances which I might mention of the same kind, a concussion of the spinal marrow makes

the patient liable—and sometimes almost immediately—to mortification of the parts below.

Patients are more or less liable to mortification from pressure, accordingly as they are more or less emaciated. A man with a good cushion of fat between the skin and the os sacrum, or the skin and the great trochanter, is not so liable to the formation of sloughs in those parts as a thin one; and that for obvious reasons.

When you suspect that pressure on any part is so great as to be likely to occasion mortification, you can do nothing but remove the pressure. When a bandage is placed in a case of fracture, you must remove it as soon as you suspect that the swelling of the parts has made it very tight, lest mortification should follow. When a patient has been so long confined to his bed, that you expect mortification will take place, you must endeavour to guard against it. It is more easy to prevent it than to stop it when it has once begun. How, then, is this to be accomplished? If a patient lies on his back, the skin sloughs over the os sacrum; if on one side then it sloughs over the great trochanter. Endeavour, when you can manage it, to make a patient vary his posture. If he can be shifted, let him lie at one time on his back; at another on his side: nay, let him turn round, and lie occasionally on his face. If you have what they call a prone couch, properly constructed for the purpose, he may, in many instances, use it to great advantage. In one of the worst cases of this kind, when mortification had begun, I used to turn the patient on his face many hours in the day, and with perfect success. But sometimes the patient cannot be shifted. There may be fracture of the thigh, and he must lie always on his back. You must then endeavour to take off the pressure by other means—by an air cushion with a hole in the centre, the tender part over the os sacrum being in the hole of the cushion. But in all cases where you use an expedient of this kind, you should first apply a piece of common soap plaster, spread on calico, over the part, to support it. If you merely place the hole of the cushion under the os sacrum, the skin will bulge into the hole, and the patient will lie as bad as if there were no hole at all, or even worse. The same rule applies to all cases where you use contrivances to take off pressure, as in those of corns and bunions. In cases where you can have recourse to it, the water-bed is very useful in preventing mortification from pressure. Dr. Arnott's hydrostatic or water-bed diffuses the pressure everywhere. When you lie on a mattress, the pressure is thrown on all the prominent parts of the body, and little elsewhere; but in using the water-bed the water rises to fill up the hollow places, and the pressure is not greater on the sacrum than on other parts. No doubt this bed is the best method which has yet been contrived for preventing mortification from pressure—the only objection to it is, that it is not applicable to all cases. In cases of compound fracture of the thigh or leg, for example, it would not give sufficient steadiness to the injured limb.

But another plan may be adopted to prevent mortification from pressure—that is, to prevent the inflammation which precedes it. The thicker the cuticle the more it will protect the parts beneath it.

You may, if you attend to it in time, add to the thickness of the cuticle by stimulating the surface of the skin. Nurses know this very well, for when patients are bed-ridden, they wash the parts subjected to pressure with brandy. What is better, is a lotion composed of two grains of oxymuriate of mercury to an ounce of proof spirits. When you think that a patient is likely to be confined so long in bed that there may be mortification from pressure, wash the parts two or three times a day with this lotion. I have found it useful in other cases where a patient suffers from pressure. A man has a rupture which requires to be supported by a very powerful truss. It galls and frets the skin, and may at last cause inflammation and sloughing; but under the use of the lotion, a thicker cuticle is generated and this mischief is avoided.

The sores which remain after the separation of a slough produced by pressure, are to be treated like common sores; this being kept in view, the skin will slough again if pressure be continued. You must, if possible, contrive to take the pressure off these sores; but, unfortunately, it is not always possible for you to do so, and in spite of all your care and trouble, slough will form after slough, exposing the sacrum or trochanter, or other bony structures, whatever they may be.

MORTIFICATION FROM CONTUSIONS AND TRAUMATIC GANGRENE.

I now come to speak of mortification from a blow or other mechanical severe injury. It may be said that pressure is mechanical injury, but I now speak of sudden injury operating for a short space of time such as a contusion or a wound.

The effect of mechanical injury may be to produce mortification, which is confined to the parts actually injured. For instance, a man gets a kick on the shin, and the next day there is a slough, and the skin is dead, just where he was kicked. Why? Because the kick bruised the skin against the bone, ruptured the capillary vessels, and destroyed the organization in the part, so that life could not go on. But here the mortification is confined to the part actually injured. A remarkable circumstance happens in some of these cases. The cellular membrane has not so much vitality as the skin, and therefore perishes more easily. A blow will disorganize the cellular membrane which will not disorganize the skin. A man came into the hospital who had had a severe blow on the instep; there was a purple appearance, but no very extensive ecchymosis, and I thought nothing of it. The next day I found the part inflamed, the following day there was a good deal of swelling, and on the third day the skin was beginning to slough. I divided the skin with a lancet, and found a large slough on the cellular membrane. The blow had pressed the skin and the cellular membrane against the bones of the instep, and had killed the latter but not the former. The slough of the cellular membrane would have been followed by an extensive sloughing of the skin if, acting on the principle explained in my last lecture, had I not divided the latter freely. In cases in which you

suspect that the cellular membrane may be destroyed while the skin is not, you must watch the patient, and if there be swelling and inflammation you should divide the skin, and save it from perishing as far as you can, though you cannot save it entirely.

But in other cases the mortification is not confined to the part actually injured, but may extend to the greater part of the limb. These are the cases to which the name of traumatic gangrene is applied. A man sustains a severe injury in the leg, and a great part of it mortifies. It would appear that the mode in which traumatic gangrene is produced varies in different cases. Mr. Guthrie, for example, describes a case in which mortification of the leg took place as high up as the knee, in consequence of a blow on the back of the leg. The limb was amputated, and when he came to dissect the parts it was found that the blow had lacerated the lining membrane of the popliteal artery, in consequence of which there had been effusion of lymph into the cavity of that vessel, stopping it up. That alone might not have produced mortification, but the anterior and posterior tibial arteries were torn through also, and the result of this double injury was that the limb, not getting a proper supply of blood, perished. In this case the pressure of extravasated blood might have contributed, in some degree, to produce the mortification. But local extravasation of blood, if it exist to a great extent, is, of itself, sufficient to produce this effect. When I was house-surgeon, a man was brought into this hospital with some kind of tumour about the groin, but no pulsation was felt in it, and no one suspected that it was an aneurism. There was severe pain felt in the thigh, evidently arising from pressure on the anterior crural nerve, and the event proved that there was an aneurism, though it had not been indicated by the usual signs. It burst one day into the cellular membrane; the man screamed out as if he was being murdered, so horrible was the pain. The next day there was gangrene as high up as the groin, and the man died in about a fortnight. On dissection we discovered an aneurism of the internal iliac artery, which had burst under Poupart's ligament. The extravasation of blood had prevented the circulation from being carried on in the limb, and hence it mortified. There was a man in the hospital long ago, who had popliteal aneurism. I had fixed the day for tying the femoral artery; but on the day previous to this the aneurism burst into the calf of the leg, and the next day the limb was in a state of mortification; so that instead of tying the artery I amputated the leg. The vessels below were all quite pervious, and the circulation would have gone on very well but for the pressure produced upon them by the immense extravasation of blood. No doubt, in many cases of traumatic gangrene, this is one principal cause of mortification.

But traumatic gangrene takes place in another way, and, to illustrate what I mean, I will mention the circumstance of a case which occurred in the hospital some few years since. A poor boy was jumping over a ditch, and came with considerable force upon his feet. There was a compound fracture of the leg above the ankle.

The external wound was trifling, but it was evident that a great shock had been given to the foot and leg. Four days afterwards the limb was in a state of mortification as high as the knee, and the mortification seemed to be extending to the thigh. I amputated the thigh as high up as I could, near to the great trochanter. We dissected the limb very carefully. The large arteries, and also the large veins, were quite pervious. There was, in fact, no injury whatever to the arterial trunks; but the cellular membrane, the muscles, and, in short, all the structures, seemed to be more or less disorganized. There were spots of ecchymosis in the large nerves; the periosteum was universally detached from the fibula, and very nearly so from the tibia. How does the periosteum adhere to the bones? By the small vessels. It is evident, then, that the shock of the accident must have occasioned a great injury to the small vessels connecting the periosteum to the tibia and fibula, and the probability is, that the same kind of injury inflicted on all the capillary vessels of the limb laid the foundation for the mortification. I do not see how the occurrence of mortification in cases like this can otherwise be explained.

It has been a sort of *dictum* of the schools of surgery, that you should not amputate while mortification is going on; and certainly, when there is mortification from ossified arteries (as I shall hereafter explain), or where there is mortification from inflammation, you ought to wait for the mortification being stopped, and for the formation of a distinct line of separation, before you proceed to an operation. But it must have been palpable to every body who took the pains to consider the subject, that this rule would not apply to all cases of mortification. For example, a man has a strangulated hernia; when you open the sac you find the omentum strangulated, a part of it dead, and the mortification still extending. You would not hesitate in a case like this to cut off the dead and dying omentum. If piles were undergoing the process of mortification from being strangulated by the sphincter muscle, you would not hesitate to cut them off. You may conceive many other cases, in which the cause of mortification is local, and to which the general rule which I have just mentioned does not apply. Baron Larrey has the credit of having pointed out more distinctly than had been done before, that where there is mortification from local injury, you may venture to amputate, though the mortification is still spreading. But I apprehend that the operation must be had recourse to at once, and that the case admits of no delay. If, in consequence of local injury to a limb, mortification has begun, but has not yet produced any severe shock on the system, there you may amputate. But where the mortification has been going on for some days, so that the system has begun to be influenced by it, the pulse getting weak, perhaps intermitting, and with great prostration of strength, in such a case you must not venture to amputate. Under such circumstances it is probable that the system is not in a state to bear the additional shock of the operation. However, I believe that cases enough may be adduced to prove that Baron Larrey's rule of not waiting to amputate till the mortification has stopped, is applicable in a great number of instances

where the disease arises from local injury. It is good in theory, and there is now sufficient experience to enable us to say that it is good in practice also.

LECTURE VI.

ON MORTIFICATION. (Continued.)

DESTRUCTION OF PARTS BY CAUSTICS.

PARTS may be destroyed by the application of various substances, which exercise a chemical action on the materials of which their organization is composed. We call these substances *caustics*, and sometimes *escharotics*. This is a subject of especial interest in practical surgery; and in considering it I shall not confine myself to the *modus operandi* of caustics, but I shall extend my observations to the modes of using them, and explain some of the principal occasions on which you may, in the treatment of diseases, have recourse to them with advantage. I have no scruples in doing this, as I am not restricted by the rules of a systematic course of lectures, and need have no object in view, except that of making these discourses as useful to you as possible.

I have said that caustics act chemically, destroying in this manner the organization of the parts to which they are applied. If there be any exception to this general rule, it is in the case of *arsenic*, in the operation of which there seems to be something peculiar. I make this observation, because it has appeared to me, that while other caustics have a manifest action on the dead body, it is not so with arsenic. I very much suspect that arsenic acts merely on the fluids, while ordinary caustics act on the fluids and solids also. However, I offer this to you as a conjecture, and as a matter deserving of further inquiry, and not as a well-established fact. All other caustics which I have made the subject of experiment produce a distinct alteration in the condition of the dead body, though different in appearance from what they produce on the living, in which they operate on the fluids as well as on the solids, and in which the blood moving in the small vessels conveys their influence beyond the surface to which they are actually applied.

A great variety of chemical agents may be employed as caustics. It would be an endless task for me to describe all of those with which I am myself acquainted; and if I were to do so, a multitude of others would be left unnoticed, of which I have no experience. I shall only speak of those which we are in the common habit of employing, and the right use of which will, if I am not mistaken, enable you to accomplish all that can be accomplished in this way.

There is some difference in the action of different caustics: some