which was very similar to this which I have just mentioned, and in which he amputated the thigh. In performing the operation he was surprised to find that no blood flowed from the stump, in consequence of the vessels being obliterated. The parts divided in the operation had not a sufficient supply of blood for the healing process. The stump mortified as the leg had done before, and the patient died. It appeared to me, after the evidence afforded by this case, that it was desirable to avoid an operation if possible. At the same time I ought to mention, that in the second volume of the Medical Observations and Inquiries, there is an account of a case, apparently of the same kind, in which amputation was successfully performed, the stump healing favourably.

One of the circumstances most deserving of notice in these cases is that the limb mortifies to a certain extent, and that then the mortification stops. This, however, is easily explained. We know that the obliteration of an artery must prevent the supply of blood to certain parts, but no further. Another peculiarity is, that the parts become dry, hard, horny, which condition of them has given rise to the name of dry gangrene. This is also easily explained. If mortification be the result of inflammation or of venous obstruction, there is always an effusion of serum before the parts completely die, in the form of vesication of the skin, and œdema of the cellular membrane; and then, when the parts die, being infiltrated with serum, they readily become putrid. But here the supply of blood is cut off; the blood is prevented from entering the limb, so that there can be neither vesication nor effusion of serum into the cellular membrane; and the dead parts dry readily from the absence of moisture. M. Dupuytren has described the gangrene that occurs in old age as the result of arterial inflammation, but I am quite satisfied that he is mistaken on this point. Gangrene from arterial inflammation is a comparatively rare disease, and may occur at any period of life; whereas, the gangrene of old age arises, as repeated dissections have enabled me to determine, entirely from other causes. I shall offer some observations on this kind of gangrene in the next lecture.

LECTURE VIII.

ON MORTIFICATION. (*Continued.*)

SENILE GANGRENE.

Persons advanced in life are liable to mortification of the toes and feet; generally beginning in the former, and extending to the latter. By persons advanced in life I mean those who bear upon them the marks of old age, which may, however, occur at various periods of human existence. One of the worst cases of mortification

of the toes which I ever witnessed, connected with what might truly be considered old age, occurred in a man of six-and-thirty, worn out by the operation of bad habits upon an originally bad constitution.

The question here arises, *in limine*, why is it that old persons are liable to this disease? Morbid anatomy enables us to answer this question. I have examined the bodies of a great many old persons who have died with mortification of the toes, and I have always found some morbid condition of the arteries of the affected limb. In the great majority of cases there is extensive ossification of the arteries of the thigh and leg. In many cases the arteries are not only ossified, but some of them are contracted and obliterated. Thus I have known the femoral artery to be obliterated from the origin of the *profunda* down to the ham. In other cases one or more of the arteries of the leg are obliterated, while the femoral artery is still pervious. In one case, of which I have preserved notes, the arteries were not ossified in any part of their course, but the femoral artery was converted into a gristly cord, and quite impervious from the origin of the profunda to the point at which it perforates the tendon of the great head of the triceps adductor muscle. In none of these cases, in which the arteries were contracted and impervious, were there any such appearances as would have indicated that the contraction had been the result of previous inflammation; and it appeared to me that the change which had taken place in their condition was best to be explained by supposing it to be the result of a process corresponding to that which produces stricture of the urethra or œsophagus.

It has been said that mortification of the toes in old persons is often the result of disease in the heart itself. This does not, however, exactly correspond with the results of my own experience. It is true, that I have known persons who had disease in the heart to die of mortification of the toes; but then there was always enough in the condition of the arteries of the limb to account for the mortification independently of the other disease. Thus in one case in which there was mortification of the right foot, the muscular structure of the heart was soft, thin, flaccid, and easily torn; one coronary artery was impervious; and the right iliac artery, for the extent of three inches, was impervious also, in consequence of it being completely filled by a mass of firmly coagulated blood. In another case, in which there had been mortification of the right foot, the muscular structure of the heart was pale and flaccid; one coronary artery was contracted and impervious; the cavities were dilated; a mass of dense coagulum, resembling that found in the sac of an aneurism, occupied the appendix of the left auricle, and there was a similar coagulum obstructing the popliteal artery and vein of the right side, and extending some way down the branches of those vessels in the leg.

You are not, however, to suppose that mortification of the toes is a necessary consequence of ossification or obliteration of the arteries, and that it occurs in all such cases. I have no doubt that many persons have the arteries thus altered in structure for many years, although mortification never supervenes. I have already explained

to you that in some cases the arteries are ossified, and at the same time either contracted or obliterated; that in others they are obliterated without being ossified, or ossified without being obliterated, even retaining their natural diameter. It is evident that the quantity of blood admitted into the limb must be different in these different cases, and that the liability to mortification must vary accordingly. But further than this: even where the arteries are rendered narrower, or actually obliterated, it seems that in general something more must happen to bring on mortification; and you will almost invariably find that the immediate cause is an attack of inflammation. Perhaps the following is not an unreasonable explanation of the phenomena which occur. The arteries are ossified, or they are partially obliterated; but still a sufficient supply of blood for ordinary purposes goes to the limb. By and by, from some cause or another, the foot becomes inflamed. I observed to you, in a former lecture, that during inflammation, an increased supply of arterial blood seems to be required, and that the arterial trunks leading to the inflamed part become dilated, so as to allow this increased quantity of blood to enter, but if the arteries are ossified, they lose the power of dilatation; they cannot expand; the greater supply of blood required in consequence of the inflammation is withheld, and so the part perishes.

You might suppose, *à priori*, that persons in the lower condition of life, who live hard by their daily labour, would be more liable to mortification of the toes than other persons; but such is not the case; at least it has fallen to my lot to see comparatively few cases of this disease in the hospital; whereas, in private practice, I have met with a great number; so that for one case under my care in the former I have had three or four in the latter. It is one of the penalties paid by those who enjoy the advantages of ease and affluence, and who live luxuriously. It is persons who eat too much, and drink too much fermented liquor, and do not take sufficient exercise, that are especially liable to this disease, and not the labouring poor.

Ossification of the arteries is a change that can take place only gradually; and the obliteration of those vessels which I mentioned as occurring in some cases, probably takes place gradually also. You will easily believe that, under those circumstances, certain premonitory symptoms may arise in the lower limb before the disease is gone so far as to produce mortification. If you cross-examine a patient who has mortification of the toes, he will generally tell you, that for three or four years preceding he has had occasional pains in the lower limbs; a sense of numbness in them; that his feet were liable to be cold; that when they again became warm, after having been cold, they have been very painful; and that he has had a sense of weakness of the muscles. Such patients walk a short distance very well, but when they walk further, the muscles seem to be unequal to the task, so that they cannot get on. The muscles are not absolutely paralyzed, but in a state approaching to it. All this is easily explained. The lower limbs require sometimes a larger, and sometimes a smaller supply of blood. When more blood is wanted, the arteries cannot

open to let it in, and hence arise both pain and numbness. In walking, the muscles ought to receive an increased supply of blood, but the arteries being ossified or obliterated, they are incapable of transmitting it; and this explains the sense of weakness. This last circumstance may be illustrated by what you observe in a particular disease of the heart. Dr. Jenner first, and Dr. Parry, of Bath, afterwards, published observations which were supposed to prove that the disease which is usually called *angina pectoris* depends on ossification of the coronary arteries. I will not say that such symptoms as those of *angina pectoris* can arise from no other cause, but I know that they do arise from it in certain instances. In two cases in which I examined the bodies of persons who died from the disease in question, I found ossification of the coronary arteries to a great extent, so that they were converted into complete bony tubes, while there was no disease of any consequence besides. When the coronary arteries are in this condition, they may be capable of admitting a moderate supply of blood to the muscular structure of the heart, and so long as the patient makes no unusual exertion, the circulation goes on well enough. When, however, the heart is excited to increased action, whether it be during a fit of passion, or in running or walking up stairs, or lifting weights, then, the ossified arteries being incapable of expanding to let in the additional quantity of blood which, under these circumstances, is required, its action stops, and there is syncope; and I say, that something like this may be observed in persons who have ossified or obstructed arteries of the legs.

These premonitory symptoms, as I have said, may exist for three or four years, until at last some accidental attack of inflammation occurs which induces the mortification. A very frequent occurrence is this: the patient cuts a corn, the knife goes below it, makes the toe bleed, and a little inflammation follows: or it may be, that the foot gets chilled by exposure to cold, and the patient goes to the fire to warm it, and that this is followed by a degree of inflammation which, if the arteries were healthy, would be chilblain and nothing more, but which, in their present condition, lays the foundation of mortification. A slight degree of inflammation of the toes almost invariably precedes the mortification; vesications then take place, the vesicles burst, and at the bottom of them you find the cutis to be dead. This may take place in one toe, or in many toes at the same time. Most frequently, the disease having commenced in one toe, extends to the others, and then to the feet. Frequently, in the beginning of the complaint, there is a most intense pain, but sometimes the pain is very trifling. The mortification having once begun, a little inflammation is kept up on its margin, which slowly creeps up the foot, and the mortification follows it; the constitution being probably little or not at all disturbed, the pulse remaining at its natural standard, and the patient in all other respects thinking himself well. The disease, in fact, generally has, in the first instance, a chronic form; but sometimes it is otherwise, so that it exhibits all the characters of an acute disease. The man to whom I before alluded as old in constitution, though not in years, being only thirty-six, had been a soldier, and

had served in Canada and in the East Indies—that is, in cold climates and in hot. He had, by his own acknowledgment, been a drunken fellow, and dissipated in other ways. Having been dismissed from the army as superannuated, he gained his livelihood by working as a labourer on the Edgware Road. Many times on going to work, he suffered from cold and numbness of the feet, followed by violent pain. One morning in September (not a very cold time of the year) these sensations took place to a very great extent; severe pain and shivering followed, and his friends took him home in a coach. Two days afterwards he was brought to the hospital, and then all the toes of one foot were mortified, and one or two of the other. Under the treatment which was employed, and which I need not explain at this moment, he recovered. The dead toes came away, the sores healed, and he left the hospital as cured. Two years afterwards he was re-admitted with an abscess on one instep, and a sinus running under the skin. This occurred the year after I had been elected assistant-surgeon to the hospital; and not knowing any better at that time, I introduced a director under the skin, and along the sinus, and, according to what I had been taught to do in a case of this kind, I slit open the sinus with a lancet, making an incision two inches in length. With my present knowledge, I should have acted otherwise. Some inflammation followed the wound, which extended to the foot. The next day mortification had extended up the whole foot to the leg, the pulse was frequent and weak, the skin hot, and the patient lay in a state of stupor. Two days afterwards he died. You will observe that in each of these attacks the disease had the acute form, and that in the second attack it terminated life in about four days. I examined the body after death, and found extensive ossification of the arteries of both limbs.

The more common history of the disease, however, is this: in its origin it has the chronic form, but if it goes on it sooner or later assumes the acute form. The mortification may gradually spread up the toes and feet without any urgent symptoms, and this may be going on for weeks, and even for months; then, all at once, a fresh attack of inflammation takes place, the mortification extends rapidly, the constitution suffers, the pulse becomes feeble and rapid, the patient falls into a state of stupor, and dies in the course of a few days.

There is no form of mortification which is more dangerous than that of which I am now speaking. A large proportion, indeed, of the patients who are so affected, under any mode of treatment, die. You will not be surprised, then, that a great many different modes of treatment have been proposed. Where there is a disease that always gets well under a certain system, medical men have little inducement to make experiments; and the wisest make none at all. But in an intractable disease like this it is natural that practitioners should be always looking out for new remedies. I do not pretend to speak of all the variety of remedies that have been used or recommended; but I shall allude to the principal ones.

In the first place, those who have observed that the disease is preceded by inflammation, have said, "bleed the patient; treat it like

an inflammatory disease." I have no doubt that some have been led to recommend this from a mistake respecting the pathology of the disease, which I noticed in the last lecture; that is, from having supposed that this peculiar kind of mortification of the toes depends on inflammation of the arteries. I have, however, explained to you that the two cases are quite different. Bleeding has, however, been proposed, and in one instance I saw it tried. The mortification was to a very small extent; there was but very little inflammation round it, and the patient seemed to have a very fair chance of recovery. But immediately after the bleeding the mortification extended rapidly up the foot, and he died. Indeed, it appears to me, that we have no right to expect that we shall cure this disease by taking away blood. There is inflammation, it is true; but if the inflammation terminates in mortification, it is because the part, on the principle which I just now explained, cannot get that additional supply of blood which an inflamed part requires. Now, if you abstract blood, and thereby lessen the quantity in the system, and weaken the action of the heart, the supply of blood to the limb must be diminished, and the cause of the disease aggravated.

An opposite plan of treatment to this has been recommended by others. They have said, "this is a disease of weakness; give bark, quinine, serpentaria, and other tonics." Now there are certain kinds of debility which will be relieved by these remedies, but here there is only a local weakness, depending on disease of the blood-vessels. Will such remedies as these mend the condition of the arteries? Certainly they will not: but they will interfere with the digestion; they will prevent so much food from being converted into nourishment as would be converted into it otherwise; they will prevent the exhibition of stimulants which really are useful, as I shall explain presently. I own that I have very little, I may almost say, no faith, derived either from theory or from practice, in the good supposed to be produced by the exhibition of what are called tonics. If you give any thing of the kind, let it be ammonia, combined with the compound infusion of orange peel. Ammonia for a little time may be useful; but I think there are objections to its long-continued use in this and in every other case. It appears to me that patients who take it for a long time, are at last rendered weaker by it, instead of stronger. It is an alkali, and produces the same effect on the blood that is produced by other alkalies. If it be taken, however, for a short time, it may be useful.

In the management of these cases there can be no doubt that one principal object to be kept in view is the maintenance of a sufficient supply of blood in the system. As the abstraction of blood is mischievous, so the opposite treatment is likely to be beneficial. Let the patient, then, be put on a system of nutritious diet, not overloading his stomach, so as to produce a red or yellow sediment in the urine, but taking as much food as can be easily assimilated, and no more. Let him live chiefly, but not entirely, on animal food, which makes blood—if I may use the expression—of a better or stronger quality than that derived from vegetables alone. In addition to this, the

patient will require the use of some such stimulants as ale, wine, or brandy. You will generally find that persons who have mortification of the toes, are such as have been accustomed to take a good deal of fermented or spirituous liquor, and being accustomed to it, that they cannot do without it. Nor is this all. Those whose mode of life has been different will require the exhibition of stimulants under these new circumstances. The question, however, will arise in each individual case, what is the proper quantity to be exhibited? Some persons may want a bottle of wine daily; but very few, on this, or on other occasions, are benefited by so large an allowance as this. In the majority of cases from half a pint to a pint daily will be sufficient. You should ascertain what have been your patient's previous habits, and then give him wine or ale cautiously, observing the effect produced. There is one good rule of conduct in this respect, both in health and in disease: wine that does not occasion heat of skin, that does not raise the pulse, nor make the mouth clammy, nor render the patient nervous or irritable, any quantity that does not produce these effects, may be given with advantage: but otherwise it does mischief.

In all cases of mortification of the toes, I have observed it to be of great consequence to attend to the state of the digestive organs. If the bowels are not in a proper state, the food cannot be properly assimilated; and the patient being confined, as he must be, to his bed, the bowels will not act without assistance. I do not advise you to give purgatives every day, but rather an active dose may be required once in three or four days; such as two or three grains of calomel at bed-time, with an aperient draught on the following morning, or blue pill with compound extract of colocynth; and all my experience leads me to believe that this is a very essential part of the treatment.

Mr. Pott was either the first who recommended, or the first who brought into general use, the exhibition of opium in cases of senile gangrene. What is the *modus operandi* of opium here I will not pretend to say; but I can have no doubt, from all the experience that I have had, that there is really no internal remedy so useful as this. I can scarcely remember meeting with a single case of recovery in an old man, from mortification of the toes, in which opium had not been exhibited. But it is with opium as with wine; a good deal of discretion is necessary as to the exhibition of it. You must not begin with very large doses of opium; they are too powerful for the constitution, and opium is mischievous if it keeps the patient dozing all the day. You may at first exhibit half a grain, three times daily, and keep him slightly under its influence, but nothing more. If he continues to take it (and sometimes this may be necessary for months together), the dose will require to be increased; but you will never be able to persevere in the use of opium, except you employ in combination with it those remedies which I last mentioned. Not only purgatives, but mercurial purgatives, are required by all persons who take opium in this manner, otherwise it stops the secretion of bile, and does mischief. The result of the case will very much depend on this—whether opium does or does not agree with the patient. If opium induces a feverish state of system, if it disturbs the sensorium,

if it interferes in any way with the digestion of the food, and especially if it makes the tongue brown and dry, it can do no good; while the mere healthy action of it will be almost certainly beneficial.

With respect to the local treatment, the first thing is to keep the patient in bed. Not feeling very ill, he probably will wish merely to lie on the sofa; but this never answers; therefore send him to bed at once. If he strives against it for the first few days, he will be driven to bed at last, and will be worse than if he had gone there in the first instance. I think a great deal of the success of the treatment will depend on his being placed in the uniform warmth of bed at the very commencement of the attack. Rest in bed, in the recumbent posture is essential. Then, what local treatment is required besides? It is common to apply poultices made of grounds of stale beer, or of red wine and oatmeal, and some recommend a solution of chloride of soda. I was accustomed formerly to rub the legs and thighs with a stimulating liniment, but I soon left off this practice, finding that it did no good; and I believe now, that, if it does any thing, it does harm. Why do the toes mortify? Because when inflamed they do not get a sufficient supply of blood. Rub the thigh and leg with a stimulating liniment, and it is the same thing, only less in degree, as blistering them: and what would be the consequence of applying blisters? It would draw the blood to another part. You want it in the foot, and you draw it elsewhere. It is something like taking blood from the arm, not indeed so mischievous: less in degree, but the same in kind. Then, I must say, that I have never seen any good from it in practice. Neither have I any reason, from what I have seen, to believe that those other applications which I have mentioned used as poultices and lotions are of any use.

Some few years ago I was in consultation with the late Mr. Vance, of Sackville Street. He had been surgeon for many years to Greenwich Hospital. Being always anxious to obtain what information I can from others, I observed to him, "You must have seen among the old men at Greenwich, a great number of cases of mortification of the toes. What have you found, on the whole, to be the best local treatment?" He answered, that he had found nothing to answer so well as wrapping up the parts in carded wool. I did not understand from him whether he wrapped up merely the foot or leg, or the whole limb; but he added that he usually left it on for many days. It struck me that this was a very reasonable kind of practice. Wool is a very bad conductor of heat, and wrapped round a limb it must keep it of very uniform temperature, and at any rate save, in a great degree, expense and trouble of generating animal heat. Soon afterwards, I had an opportunity of adopting Mr. Vance's mode of treatment. I had been poulticing a foot as usual, and the disease was going on spreading from one toe to another, and up the foot. Carded wool is so prepared that it may be drawn out in long flakes several feet in length and in these I wrapped up the foot; and then, thinking that I had better proceed further, I wrapped up the leg and the thigh also, as high as the middle of the thigh. I applied it rather loosely, one flake over another, until the limb appeared to be three or four times

more bulky than it was in its natural state. The result was excellent. The mortification never spread from the time that the wool was applied, and the patient recovered. I have employed the same local treatment since in other cases, and although, of course, it would be absurd to represent it as always successful, yet I feel bound to say that I am satisfied that it produces much better results than any which I have ever employed.

In employing the wool, recollect that you should apply it loosely and uniformly, and plenty of it. You may afterwards sew it all up in a silk handkerchief, and leave it unopened for several days, sometimes a week. You may lay a simple dressing of calamine cerate on the mortified parts, replacing it whenever you change the wool. If the mortification stops, and the slough is coming away, you may, on account of the discharge which takes place, change the wool every other day. The carded wool possesses, as a little consideration will prove to you, many advantages over the poultices. In the first place, if you use poultices the limb is exposed alternately to cold air and hot poultices three times every twenty-four hours, that is, to repeated changes of temperature. In the intervals, it is at any rate left to generate heat as usual. But if you wrap it up in carded wool, both these things are avoided. In another respect, also, this mode of treatment is a great comfort to the surgeon, the patient, and the whole family. Two or three times daily, whenever the poultices are changed, the family inquire, "Is he better? is he worse? is the mortification stopped?" You are called upon to answer these unanswerable questions, and the patient's mind is kept in a constant state of excitement. But if you put on the carded wool, and leave it there, his mind in the interval is tolerably tranquil: he lives upon the hope that when the wool is next taken off the parts will be found better; and such a state of mind is much more favourable to his recovery than the nervous anxiety which he experiences when the limb is examined more frequently. I believe that there are very few cases to which you will not find this method of treatment applicable. If there be any, it is those in which there are great inflammation and heat of skin, and in these it may be prudent to defer the application of the wool until these symptoms are abated.

Whenever the mortification is arrested, you will be made aware of it by a line of separation on the margin. The process of separation proceeds, in favourable cases, until the bones of the toes come away. You may have to cut through some dead ligaments and tendons, in order to promote the separation of the offensive and putrid parts, but you must cut through nothing else. If you apply your knife to living parts, you will certainly bring on a fresh attack of mortification. Leave the separation altogether to nature, and the natural process will do all that is required.

But there is another question. A man has mortification of the toes, and, independently of experience, you might naturally say,—here is a most dangerous disease; why not at once amputate the limb? It is probably unnecessary for me to tell you that it would be contrary to all the old rules of surgery (for which I have great

respect) to amputate a limb under such circumstances. I have never seen it done; I have never done it myself, but I have heard of cases in which the surgeon was, shall I say fool enough or ignorant enough? to venture on this summary proceeding of cutting off the leg, because the toes were beginning to mortify. In every instance the stump mortified directly, and the patient died. The chance of recovery from mortification of the toes is not very considerable—that is to say, there is a great chance of the patient dying; but still, under proper treatment, there is also a fair chance of recovery, and you ought not to risk this chance by inflicting on this diseased limb so severe a local injury as belongs to amputation.

I have told you that disease of the arteries lays the foundation of mortification; but the disease may exist many years without mortification supervening, until some accidental circumstance brings on inflammation. I have known persons with disease of the arteries, and several toes mortified in consequence of it, in whom the mortification has stopped, the sloughs have separated, the sores have healed, and who have lived for years afterwards. I know a gentleman who is now alive, and in good bodily health, at least he was so not long since, whom I attended for mortification of the toes nearly five years ago. This patient was treated on the carded wool plan, and I cannot but suspect that it did something more than relieve the disease at the time. At all events, it may be admitted as a question, whether the keeping the limb wrapped up in the carded wool, which is like keeping it in a vapour bath, may not ultimately produce some beneficial change in the condition of the diseased arteries; not, indeed, removing the phosphate of lime, which is deposited in their structure, but leading to their becoming gradually and slowly expanded, so as to allow of a more liberal supply of blood to the limb. Whether this suspicion be or be not well founded, I suppose that no one will doubt that it will be prudent in all cases to advise the patient, after his recovery, always to wear a thick fleecy hosiery stocking, or to use some other kind of warm clothing, so as to preserve the limb from the influence of the external cold.

I must add a very few words respecting the treatment during the process of separation of the dead parts. Bark, quinine, and other tonics, may be useful now, though they were not so before. Wine, and a generous diet, are still required; and some stimulating dressings, such as the unguentum elemi compositum, may be useful applications to the sores.