

## CLINICAL LECTURE

ON

### DELAYED UNION AND NON-UNION OF BONES.

By GEORGE W. CALLENDER, F.R.S.,  
Surgeon to St. Bartholomew's Hospital.

AMONGST the cases in Harley Ward, gentlemen, is that of a man aged 43, who has broken his right leg; and, although it is true that, in the great majority of instances, our fractures are easily managed throughout their repair, yet, as in the present case, it occasionally happens that we have anxiety as to the result, or are obliged even to be content with a repair which is faulty either as regards the look or as regards the utility of the limb. I may have an opportunity for showing to you, by some cases in point, how we are sometimes unable to prevent the latter unfavourable ending. I now, however, propose to tell you of the trouble which occurred in the case to which I have referred, to give you its explanation, and to point out some common causes of delay in the union of bones, which, if not counteracted, furnish the greater number of cases of so-called non-union of fracture.

This man fell into a well, and, striking his right leg against a piece of timber in his fall, was brought to the hospital with a transverse fracture of the tibia and fibula—a fracture caused, you will observe, by direct violence. The injured limb was placed on a back-splint, and swung in the ordinary way; and, fourteen days later, the apparatus was readjusted. It was not, however, until the expiration of thirteen weeks that the bones united, and then not firmly; so that his leaving the ward has been delayed until the present time, nearly sixteen weeks after the accident happened; whilst, as most of you are aware, five or six weeks, in an ordinary case, would have sufficed for the cure.

Soon after this man's admission, we noticed that the limb was becoming œdematous; and this œdema persisted, increasing the size of the leg, with a firm and dense hardness of its tissues, for nearly all the time during which union of the fracture was so slowly progressing. This œdema indicated, as it always does in these cases, obstruction of some large venous trunk. The violence which breaks the bones of a limb, especially when applied directly, causes bruising of the soft parts about the fracture, as shown in an ordinary way by ecchymosis of the tissues; and if, as sometimes happens, a considerable vein be torn, or flattened by the pressure against it of displaced bone, we find that its canal becomes obstructed by a clot of blood both above and below the seat of injury, and in this way circulation through the vessel is arrested. We frequently have opportunities of seeing this condition of the veins in cases of severe fracture which terminate fatally; and in the *System of Surgery* I have referred to several *post mortem* examinations in which this obstruction of the veins was shown to have existed. When a great vein is thus closed, the balance between the arterial and venous vessels in the limb is so disturbed that, whilst the usual arterial supply continues, the veins which are left unhurt are unequal to carry off the venous blood; and thus there follows after a while that ordinary relief of the over-distended veins by which the œdema of the extremity is established, and during the continuance of which the repair of the fracture is sure to be slow, if, indeed, it make any progress at all. When, then, you see this state of things—an œdema beginning and persisting after a fracture—you may be sure your patient will make a very slow recovery from the injury.

I refer you to the remarks I have made elsewhere (*System of Surgery*, vol. iii, p. 366) for an explanation of the manner in which the clot is, by degrees, so altered in its character as to allow the re-opening of the vein. Either it, the clot, shrinks to one side of the vessel—that to which it is most firmly held by the secondary clots extending into collateral branches; or it is slowly tunneled through by the action of the blood-stream. With either, the subsidence of the œdema marks the completion of the process, and more rapid repair of the fracture ensues. And let me add that this is the usual way in which the circulation rights itself; for, in these cases of occlusion of large veins with fracture, the obstruction is not compensated for by any change in, such as dilatation of, the other veins of the limb, although these vessels may have been unhurt at the time of the accident.

Such is the explanation of delayed union in not a few cases; and in such cases, knowing the cause, and the attendant symptoms being well

marked, you will be prepared to allow an unusual length of time to elapse before you will expect firm union of the bones. Even after union has taken place, it is especially necessary to guard these fractures, as the patient first begins to move about, with the gum-and-starch bandages, of which, let me add, you will find the use far preferable to that of the plaster of Paris, of which patients complain as heavy and uncomfortable.

It is surprising how long union is delayed in some cases. I have known it deferred, in the case of a woman whose thigh-bone was broken, for ten months; her history was told by Mr. Whitmore at the Abernethian Society last session. In the case of a soldier, the humerus was two years and a half before it united; and in Mr. Stanley's case—the one in which he first inserted ivory pegs—two years elapsed before the femur was repaired. Now, in any of these cases, if treatment had not been persevered with, the delayed union would have drifted into the state known as that of non-union—a trouble which we should seldom witness if the causes of delayed union were more closely examined, and time allowed for, or treatment adapted to, the wants of each case. As it is, non-union of a fracture is a rare occurrence. Lonsdale, Hamilton, and others with large experience, have rarely met with such cases in their own practice. Here, in our wards, I find there has been but one case in two thousand five hundred fractures, excepting, of course, certain fractures, such as the transverse of the patella, to which I will presently refer; so that, the occurrence being so rare, it is, in my opinion, quite needless to seek for its explanation in the constitutional conditions you will find enumerated in surgical works. Age, pregnancy, debility, paralysis, may be dismissed from consideration; and, as to the influence of syphilis, you have only to visit any one of our accident wards, and you will find evidence enough to prove that it is no obstacle to the repair of fractures. Nor has the seat of the injury, including the relation to the nutrient vessel, anything to do with the non-union of the broken bone (with the exceptions I will presently name); although the delay in union may be thus explained, and great care in the treatment may be thus in some cases called for.

It must be admitted, however, that some conditions, chiefly of a local character, absolutely prevent a broken bone from being mended. Such fractures as result from cancerous infiltration of bone are practically irremediable; so also are those which involve a bone atrophied from disease. There was an instance of this some four years ago in the hospital wards, in the case of a man who had the lower end of the femur hollowed out into a large abscess-like cavity, the wall of which, thin as parchment, had cracked across at the condyles, and would not repair. Then, again, there are cases in which foreign bodies interpose between the fractured ends, of which Sir Jame Earle's case of a portion of deltoid muscle getting between the broken pieces of a humerus, and the occasional wedging of a piece of broken and subsequently necrosed bone between the fractured ends, are instances; and, lastly, other cases in which it is difficult, sometimes impossible, to keep the broken portions in apposition, as in some cases of fracture at the neck of the thigh-bone, and in most instances of transverse fracture of the patella, which is an injury almost invariably repaired by fibrous tissue. But, if we allow for these cases, we have remaining some instances of non-union which do not admit of explanation on such local grounds, and which are generally referred after a time to air, to age, sometimes to youth, or to some of those constitutional conditions which I have ventured to tell you cannot be credited with the occurrence of non-union; although one, perhaps—namely, debility—may be responsible for delayed repair. From such cases, a certain number may be deducted which, without question, have been badly treated by inexperienced or untutored persons—fractures occurring on board ship, and the like; and then, of those which remain, it is within my experience that they are examples either of delay in the process of repair, as from the obstruction of veins, or of delay through the interposition of certain mechanical difficulties; and in these cases a favourable result may be generally obtained by treatment. For convenience in mentioning them, these latter may be referred to as fractures with certain displacements of bone, fractures extending obliquely through bone, and fractures in the vicinity of, not extending into, joints; and in each of these delayed union may be traced to the fact that sufficient time has not been allowed in the first instance for the firm union of the bones; for in each a longer time is needed than is thought necessary in the case of other, or, as they may be termed, ordinary fractures.

The fractures with displacement may be illustrated by an example taken from the femur. Quite recently, a youth has been under treatment in my wards with a fracture of the femur, which had been treated on board ship, and which had united very slowly, with shortening and a considerable bend outwards of the shaft of the bone. The patient was himself conscious of the weakness, as he called it, of the limb when he first began to move about; and he was aware that the bending o

the bone had increased at this time, which was before his admission here. In fact, the union, which might have been sufficiently good to support the weight of the body if the two parts of the femur had united so as to preserve the proper axis of the limb, and to allow the shaft to bear naturally the pressure from above, was insufficiently firm to resist the same pressure when brought to bear upon a shaft in which the fracture was joined at an angle; and the uniting tissue, under these circumstances, yielded, and in time, it is not unlikely, had he persisted in moving about, would have given way altogether, and we should have had a case of what would be termed delayed union. It would have been said that the patient had moved about before the union was firm; or that, from some cause or other, firm union had been delayed; whereas the union was probably as good as in ordinary cases suffices to support the body, but in this instance was overstrained by the weight pressing at an angle instead of in the proper long axis of the thigh-bone. This case, then, represents a class in which longer time should be given for the consolidation of the repair than is needed when the long axis of the shaft can be properly preserved during the progress of union.

It is a somewhat similar condition which exists in cases of oblique fracture. The tibia—the bone of the leg which sustains the weight of the body—is often fractured so that two very oblique surfaces are left in contact. These specimens from the museum are examples of this injury. When such a hurt has to be treated, I always allow an extra fortnight—say six weeks in all—before the apparatus is disturbed and the patient allowed to put his foot to the ground; and for this reason. In these fractures, the whole weight of the man falls on and strains the new material, which has joined the fracture, in such a fashion that there is always a tendency for the upper fragment to glide off, or to be launched as it were, from the lower; the latter part of the bone giving little if any support, whilst in a transverse fracture, or a fracture only slightly oblique, it largely assists in bearing the superincumbent weight. Imperceptibly, it may be, in such a case, the union gives way; pain is felt by the patient; and, on re-examining the limb, repair is found to be incomplete. All the cases of non-union of the bones of the leg which have been brought under my notice, have been instances of oblique fracture; and every now and then, in these wards, we have found it necessary to put up afresh a fracture of this kind, upon which a patient has been allowed too soon to bear his weight.

Of fractures near a joint, that of the humerus in its lower third is, perhaps, of all the one most often followed by non-union. Various explanations have been offered with reference to this particular failure of bony union; but certainly in one case we could trace it to this, and I suspect, in most cases, it is in this direction that the cause is to be looked for. A fracture of the humerus is put up; and the forearm, at least for convenience, is placed at a right angle, and slung. As the case progresses, a question is raised as to the possibility of the elbow being stiff. The hand and forearm are flexed and extended a little, and the joint is said to move freely. If this examination be repeated, you must not be surprised if you find, when in due course you come to examine the fracture, that it has not united. The elbow being for the time somewhat stiff from disuse, it was not the joint which moved, but the fracture which was rocked in flexion and extension, as it easily may be when you act on it with the great leverage given you by the forearm, and so was hindered from becoming firm. I never knew an elbow-joint to be anything but temporarily stiff after a fracture of the humerus not extending into the joint; so that in these cases there is no excuse for handling the forearm. The arm should be left perfectly at rest during the entire process of repair; and no movement of the elbow should be permitted until it is certain that the bone is firm.

If you remember these as typical of certain classes of cases, you will be prepared to prevent the occurrence of non-union in most of the comparatively few cases in which special care will be called for. Of another class—that of failure of bony union from the difficulty of keeping the separate fragments in juxtaposition, as after transverse fracture of the patella—you may learn from this patient, recently discharged from Harley Ward, who has sustained an injury of this nature, that it is not impossible to obtain osseous union even under what at first may appear unfavourable circumstances, if only you give time for the process to complete itself, and take care that in the meanwhile no strain is allowed to stretch the fibrous tissue which at first unites the pieces of the broken bone.

**HÆMORRHAGE AFTER TONSILLOTOMY.**—As a means of preventing the sometimes severe and obstinate hæmorrhage which attends excision of the tonsils, M. Broca recommends compression of the carotid artery against the transverse process of the sixth cervical vertebra, so as to allow the formation of coagula in the small tonsillar vessels.

## ON THROMBOSIS AND EMBOLISM: CASES WITH COMMENTS.\*

By GEORGE JOHNSON, M.D., F.R.S.,

Physician to King's College Hospital; Professor of Medicine in King's College, London; etc.

WITHIN a comparatively short period, I have met with a considerable number of cases of disease in which fibrinous coagula, large or small, either fixed or movable and floating within the circulatory system, have played a conspicuous part; and I trust that a brief narrative of some of these cases, together with some reflections suggested by them, may not be without interest for this Society. I will preface the recital of the cases by a very few general remarks.

The chief among the conditions which are known to determine the formation of coagula within the circulatory system are the following.

1. Stagnation of blood, or retardation of the blood-stream—as, for example, in an aneurism after ligature or compression of the artery; in the right side of the heart when there is an impeded escape of blood through the lungs or through the left side of the heart. Amongst the causes of an impeded flow of blood through the lungs, may be mentioned the state of apnoea which results from pneumonic consolidation from the pressure of liquid on the pleura, or from obstruction in the larynx. The operation of tracheotomy too long deferred may fail to save life, in consequence of coagula within the pulmonary artery, the right cavities of the heart, and the systemic veins. A coagulum may form in a dilated left auricle, consequent on constriction of the mitral orifice. Of this there is a good example in one of the specimens on the table. Again, coagula may form in the right side of the heart when, in consequence of weakness of the walls or dilatation of the cavities, there is an incomplete emptying of these cavities and a partial blood-stasis.

2. Coagula will form and adhere upon any part of the interior of the heart or of the vessels which may have been roughened or abraded by disease or accidental injury. Thus fibrinous concretions form upon the surface of a cardiac valve which has been roughened by inflammation, upon the rough ends of a ruptured tendinous cord, upon the edges of a crack in the endocardium or in the inner coat of an artery; and the blood may coagulate and form a thrombus within an artery which has been roughened by atheromatous or calcareous degeneration, or by syphilitic or other forms of inflammation.

3. A small coagulum often forms the nucleus of a larger concretion. Thus, as layer upon layer of laminated fibrine forms within an aneurism, or on the warty concretions covering an inflamed cardiac valve, so a nucleus of coagulated fibrine within one of the cavities of the heart may rapidly increase by determining a further deposition upon its surface; so minute floating particles of fibrine—capillary embola—may lead to the formation of larger coagula in the systemic veins, in the right side of the heart, or in the pulmonary vessels.

4. There is reason to believe that in certain states of system, such as are found, for instance, in rheumatic subjects, the blood contains either an excess of coagulable material or material which is more than ordinarily prone to coagulate, possibly in consequence of the presence of some morbid material in the blood.

My first three cases are examples of thrombosis in the right side of the heart—a result, as I suppose, of weakness of the heart's walls, dilatation of the cavities, and consequent partial stasis of blood in holes and corners of those cavities.

**CASE I.**—Mr. H., aged 64, had not been in his usual good state of health for about four months before his death, which occurred on October 25th, 1871. In June, he had an attack of what was called “gastric disorder”, after which he suffered from shortness of breath on walking uphill. On one occasion in particular, while walking up a steep hill at Dover, his breathing became very difficult. This was at the end of September. Immediately after this, he returned to his home in London, where I saw him occasionally with my friend Dr. Lavie, who was in daily attendance upon him. Mr. H. was then confined to his room with a feeling of general weakness, a quick and feeble pulse, hurried breathing on any exertion, some oedema of the ankles, and crepitation over the bases of both lungs. The heart's impulse was feeble, but there were no abnormal valvular sounds. The urine was normal. One of the most distressing symptoms was a sensation of alarm and impending suffocation on first awaking. There was a considerable amount of subcutaneous and abdominal fat, and we con-

\* Read before the Medical Society of King's College.