

the less true that, in practice, the problem cannot and ought not to be stated as the Académie de Chirurgie stated it.

I rejected primitive amputation because it was not indicated, and because I could hope that it would not become necessary; I rejected it, and did not postpone it. If later I propose amputation, it will be because complications which I knew to be possible, but the appearance of which could not certainly be foretold, have arisen and have caused an indication which might possibly have remained absent.

In a word, in these great traumatic lesions we propose amputation when it becomes necessary; but we are never free to say in advance that we shall perform it at any one period of the disease rather than at another.

(The patient who was made the subject of this lesson suppurred for more than six months, lost three large fragments, and recovered finally with a solid callus, consecutive to the bony transformation of the granulations, and with a hyperostosed tibia. He left us, walking with crutches, he came to see us twice during the following three months, still unable to do without crutches; since then we have not seen him.)

LECTURE XIV.

FRACTURES OF THE LEG.

- I. Compound fracture of the lower third of the leg with small wound and emphysema. Distinction between primitive or aërial emphysema, and consecutive or gangrenous emphysema. II. Fracture with large vertical wound and commencing gangrene. Imminence of dangerous septicæmia—Amputation.

GENTLEMEN: I. *Fracture with small wound and emphysema.*—We saw this morning a man who was admitted yesterday with a compound fracture, the wound being a small one, below the middle of the leg very near the place of election, of which I have so often spoken. It is one of those cases in which we have a right to expect recovery without suppuration, by means of occlusion with collodion. I call your attention to-day to a peculiarity which is not often seen. Placing your fingers over the fracture and pressing lightly you feel the fine crepitation which characterizes emphysema. Light percussion by snapping with one finger, gives sonority. We have then here an infiltration of gas about the wound. This complication, or rather this coincidence, was pointed out for the first time by Velpeau in 1839,¹ was well studied by one of his students, Dr. Boureau, in 1852,² by Morel-Lavallée,³ and lastly by M. Demarquay.⁴

¹ Velpeau, *Traité de Médecine opératoire*, 2d édition, tome ii. p. 321.

² Boureau, *Thèse de Paris*, 1856.

³ Morel-Lavallée, *Gazette Médicale*, 1863, p. 520.

⁴ Demarquay, *Traité de Pneumatologie médicale*, p. 289.

Whence comes this gas, and what is its signification in the prognosis?

Opinions varied upon the first question because it is difficult to give a rigorous demonstration of the way in which this emphysema is produced. I admit, with M. Demarquay, that it might arise in two ways, either by the infiltration of the external air into the subcutaneous cellular tissue, or by the spontaneous production of gas consecutive to a perversion of nutrition causing either a decomposition of the tissues, or an exhalation similar to that which takes place in the stomach and intestines of nervous people. I think that here we have to deal with the first variety, infiltration of external air, and that this air was introduced through the wound by muscular contractions which during and since the accident have caused a sort of aspiration about the little wound, according to the mechanism so well described by Morel-Lavallée. It is then a primitive and not a consecutive emphysema, as it would be if it resulted from the spontaneous formation of gas in the tissues.

I base this opinion upon two reasons: 1st. The emphysema appeared early, for twenty-four hours have not yet passed since the accident. Emphysema by decomposition and exhalation rarely appears before forty-eight hours. 2d. Its appearance was accompanied by no serious general symptom; neither chill, nor quickening of the pulse, nor augmentation of the temperature, nor delirium, etc. Emphysema by decomposition, preceding traumatic gangrene, is accompanied by grave general symptoms which announce a speedy death.

For the second question, that of the clinical signification, I hesitate no more than for the first. This emphysema indicates nothing serious. Velpeau and Boureau, in saying that it indicated approaching death from which the patient could be saved only by prompt amputation, committed an error which it is easy to understand. Writing at a time when no one had yet spoken of this phenomenon, they remained under the impression of the facts which they had witnessed, in which the injury ended promptly in death. They were led into error by one of these circumstances: either the death was caused by the wound itself, without the emphysema having added anything to the gravity of the situation; or instead of a primitive emphysema by the entrance of the outer air, they had perhaps to deal with a consecutive or gangrenous emphysema, which they were not able to distinguish from the first.

To-day we are perfectly informed upon this point by the observations of the clinicists, and by the experiments of M. Demarquay upon animals. Infiltration of air giving rise to this primitive emphysema without fever is in itself not dangerous, adds in no way to the gravity of the wound, and by no means indicates amputation.

Watch this patient carefully, and I can assure you that if, as I hope, the small wound cicatrizes without suppuration, the infiltrated air will be slowly absorbed, the emphysema will disappear in four or five days, and the fracture will behave like a simple one.

(These predictions were verified, and the patient left the hospital three months after his admission.)

II. *Fracture of the leg with long vertical wound and commencing gangrene; amputation.*—We have had, gentlemen, for two days in No. 45, a teamster 45 years old, quite vigorous, but addicted for the last ten years to the use of alcohol, over whose right leg one of the wheels of his heavily-laden wagon passed. We found yesterday morning, the first day of the accident:—

1st. A fracture of both bones, of the toothed variety, a little above the junction of the middle and lower thirds, with very few splinters.

2d. A wound upon the anterior part of the limb five inches long, and parallel to the axis of the limb; or, if you prefer, to the adjoining crest of the tibia.

3d. A quite extensive loosening of the skin on the outer and inner sides of the wound.

4th. A denudation of the two fragments of the tibia, that is, a disappearance of the periosteum from the outer and inner faces of these fragments for a distance of at least an inch from the fracture.

This compound fracture is one of the most dangerous that you can meet. It does not owe this gravity to the multiplicity of the fragments, and to the crushing of the bone and the medullary substance. If this crushing existed with the other conditions of which we are witnesses, we should be in presence of the variety which is unquestionably the most dangerous of all fractures of the leg. That which gives the prognosis in this case an unfortunate character is first the alcoholic habit, a habit which, without our being able to explain it, renders the subjects much less likely to recover from great traumatic lesions; and second, the action of the body which produced the injury. This evidently is a fracture by direct cause; now in all these fractures the effects of the contusion of the soft parts are necessarily added to those of the solution of continuity of the bone, and as the wagon was very heavy, we may fear that the contusion has been severe enough to ultimately produce gangrene, if not of the whole limb, at least of a notable part of the skin. Now, at the time of the first examination it was precisely gangrene of the loosened skin which I declared possible and even probable. Upon what did I base this fear? First, upon the commemoratives which indicated the passage over the leg of a very heavy body.

Notice well, gentlemen, that the wound is a vertical one. Now how can the wheel of a wagon, passing transversely or obliquely across the leg, produce a vertical wound? It does so by forcibly pressing the skin against the crest of the tibia which becomes, in consequence of this pressure, the real vulnerant body, and cuts, from within outwards, the skin forcibly stretched over it. Certainly, it is not because the crest of the tibia has been the vulnerant body for the skin that the wound is dangerous; but this mechanism of the wound necessarily supposes very violent pressure, and consequently the most serious results of the contusion.

Notice, also, that the skin is loosened for a certain distance about the wound. You know what this loosening is, for I have often spoken about it; it is the result of great oblique pressure, that is to say, it is produced by very heavy vulnerant bodies which, instead of concen-

trating their action upon a point parallel to the axis of the leg, pass transversely or obliquely across this axis. The wheel of a wagon, a rolling cask, act in this way. Now, in passing obliquely, the vulnerant body slides the skin over the subjacent layers and causes more or less extensive rupture of the subcutaneous connective tissue. It is precisely this rupture which explains the loosening seen in our patient. You understand that by this loosening a large number of the blood-vessels which go from the subcutaneous layers to the skin are torn, and consequently this membrane loses a part of its means of nutrition. You know, also, that the pressure crushes and destroys part of the capillaries and nerve-filaments, another cause of the death of the skin. Consequently a patient over whose leg the wheel of a wagon has passed, causing a vertical wound, a loosening, and a violent contusion of the skin, is much exposed to gangrene of the latter. He may also, if the pressure has extended far enough to cause rupture of the deep vessels and nerves, have gangrene of the whole limb. You saw me yesterday seek the pulsations of the dorsalis pedis and posterior tibial arteries. Having found them easily, I concluded that the tibial arteries had remained intact, and that doubtless the patient was not exposed to general gangrene of the limb, gangrene which I should have considered imminent if I had not found these pulsations upon the wounded side and had found them on the other. But I still feared mortification of the skin, and for that reason I spoke to the unfortunate man of amputation of his leg. He refused and asked for twenty-four hours for reflection.

This morning you saw that the skin about the vertical wound was cold and insensible to the prick of a pin, and that it presented a yellow-brown or livid colour, which it did not have yesterday. We also found on each side and behind an emphysematous crepitation which I attribute to commencing putrid decomposition of the connective tissue. The patient has as yet no traumatic fever. But this fever will undoubtedly soon appear, and that is why I urged the patient to submit to amputation.

Why did I urge this? First, amputation is indicated because, as the patient is destined to lose a part of the skin of the leg, the repair of the integument, supposing death not to occur, would be very slow, and all the more difficult because the bones would be very much enlarged by condensing osteitis; and if the cicatrix finally formed, it would be very thin and probably adherent to the bone, so that it would constantly tear and be covered with relapsing and rebellious ulcers which would constitute a deplorable infirmity.

Further, amputation is indicated now, and it is urgent. For to the other dangers which threaten the patient, we must add those of which the gangrene may be the occasion. For sometimes, although only the skin and subcutaneous cellular tissue have been destroyed, we see, after the third or fourth day, grave general symptoms arise, burning fever, delirium, jaundice, and prostration, followed by a rapid death.

I admit that these accidents may be attributed to traumatic fever, which is thought to-day to be a variety of septicæmia. But they

would be much more intense than usual, and it is allowable to think that this greater intensity would be due to the worse character of the septicæmia, for the putrid gases which form under the skin, and there produce the consecutive emphysema, might be reabsorbed and become the cause of a more serious poisoning than that of the ordinary traumatic fever. However that may be, in such a case, when gangrene has commenced with emphysema, death is imminent unless the putrefying part is removed in time. That is why I urged the patient more strongly than I did yesterday to submit to amputation.

Fortunately the gangrene and emphysema have not extended to the upper part of the leg, and we can amputate at what is called the place of election, and still be beyond the limits of the trouble.

(Amputation was performed. The patient did not succumb to the traumatic fever, but he was carried off by purulent infection fifteen days after the operation.)

LECTURE XV.

BI-MALLEOLAR AND SUPRA-MALLEOLAR FRACTURES OF THE LEG.

- I. Bi-malleolar fracture—Obscurity of the mechanism—Two cases, one without displacement, the other with the displacement described by Dupuytren—Different indications for the two patients—Simple retention for the first—Retention with adduction of the foot for the second. II. Supra-malleolar fracture—Displacement difficult to correct—Possible eschar in cases of this kind—Explanation by more crushing behind than in front—Principal indication is to avoid an eschar.

GENTLEMEN: I. *Bi-malleolar fracture*.—We have at this moment in the wards two patients affected with simultaneous fracture of the lower extremity of the fibula and the internal malleolus.

I give this variety of fracture the name of *bi-malleolar*, although I recognize that sometimes in the fibula the solution of continuity occurs a little above the part which, strictly speaking, constitutes the external malleolus.

In both cases the fracture was caused by a misstep in which the foot was subjected to a certain degree of torsion. I wish I could tell you if the foot, at the moment of the accident, turned about its vertical axis from within outwards, so that the outer facet of the astragalus pushed the external malleolus backwards and outwards, while strong traction was exerted upon the internal malleolus by means of the lateral ligament, and that we might, following M. Maisonneuve,¹

¹ Maisonneuve, Fractures du Péroné (Archives Gén. de Médecine, 3d série, tome vii. p. 165).

explain the fracture of the fibula by divulsion, and that of the internal malleolus by traction. Nor can I tell you if at the time of the accident the foot turned about its antero-posterior rather than its vertical axis, nor if it took, to use Malgaigne's expressions,¹ the position of adduction, or that of abduction. For the patient could give me no precise information as to the way in which his foot turned.

Reading the works of the two authors just mentioned, and Dupuytren's² much earlier one on this subject, one would believe from the manner in which they speak of the mechanism of fractures of this kind, that they were able constantly and very easily to confirm by their patients the theories which they developed upon it. But it is not so. The patients can almost never say how the foot turned, and can give the surgeon no information upon this point which can clear up his diagnosis and prognosis.

I admit willingly that we can study upon the cadaver certain points of the mechanism of fractures of the fibula, and especially that which relates to the effects of torsion of the foot. But we can never know if, in an accident, everything has taken place as in our experiments, for two reasons: first, because the patients, as I told you, do not know what has taken place; and, second, because in the living body we have, added to the torsion of the foot, energetic muscular contractions, and the weight of the body upon the lower part of the leg and the foot while they are in a vicious direction. These difficulties render the results of experiments upon the cadaver inapplicable to the clinic, and cast, it must be frankly admitted, great obscurity upon the mechanism of fractures. But on this point, as on many others, I like better to tell you that we do not know, than to give you false and incomplete explanations.

In one of our two patients the double fracture is accompanied by no deviation of the foot, and no other deformity than that which results from the swelling. The diagnosis, nevertheless, is incontestable. Not only have we found that sharp pain on pressure above the external malleolus and at the base of the internal one, which is one of the probable signs, but we were able to feel crepitation by the three principal manœuvres recommended for that purpose:—

1st. For the external malleolus, pressing with one finger upon the point of this malleolus while the other hand holds the lower part of the leg firmly; for the internal malleolus, seizing it between two fingers, and moving it backwards and forwards.

2d. Raising the leg, holding it firmly with one hand, seizing the foot with the other, the palm of which embraces the sole, while the thumb and middle finger are placed by the ankles, and moving it alternately outwards and inwards, sometimes without rotation, that is, carrying it bodily sideways, sometimes with rotation about its antero-posterior axis.

3d. Fixing the leg upon the bed, without raising it, with one hand, the fingers of which are placed over the ankle, and moving the point

¹ Malgaigne, Traité des Fractures et des Luxations, tome i. p. 808.

² Dupuytren, Leçons Orales de Clinique Chirurgicale, tome i.