ON SOME POINTS IN THE MECHANISM OF FRACTURES OF THE CLAVICLE.

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IN the number of the BRITISH MEDICAL JOURNAL for July 19th, there was a communication from Mr. Lush in regard to a case observed by him of fracture of the clavicle by the recoil of a gun; and another is reported by Mr. Prothero in the number of August 9th. In both instances, the fractures were of the simple variety, and united without difficulty.

The mere fact of these cases being placed upon record, would seem to indicate that they were thought by the reporters to be unusual. Yet accidents of this kind are, in reality, by no means rare. During the "reed-bird" season, they often occur among the sportsmen on the marshes near this city. The reed-bird, known elsewhere as the rice-bird or bob-o-link, is a small bird, flying in large flocks; and, in getting them, large loads of small shot are used. The gunners stand in boats, pushed by a man in the stern; they become careless, and are, indeed, often inexperienced, firing rapidly, and without fairly bringing the butt of the gun against the shoulder. Hence it not unfrequently happens that the recoil comes against the outer end of the clavicle, and in a somewhat downward direction if the birds be flying well over.

Duck-shooters, lying down in a boat or blind, and firing upward at birds flying high, are even more liable to this accident, the chances of which are increased by the use of very long and heavy guns.

Now, the mechanism of these fractures I believe to be, as I suggested as long ago as 1866, by leverage over the first rib. (*New York Medical Journal*, October, 1866.) It should be remembered that the sternal end of the clavicle is firmly fixed, and that the range of motion of the acromial end is but limited; and between the inner portion of the clavicle and the first rib there is often a very close relation. In some persons, the upper part of the thorax comes much more nearly to a point than in others, the arch of the first rib being smaller, and the bone itself more delicate. Again (and these two conditions, I think, generally correspond), in some persons, the clavicle is straighter and stands out more directly from the sternum, than in others. When the first rib forms a wide and strong arch, and the collar-bone runs somewhat backward as well as closer to the rib, the two bones may be almost in contact, as far nearly as to the middle of the clavicle. Under such circumstances, it may easily be perceived how sudden violence, driving the outer end of the clavicle downward, or downward and backward, would act upon it as a lever, and tend to break it at its weakest point. The rib, being a strongly stayed arch, pressed upon at its convexity, would not give way; while the clavicle would be taken at a disadvantage, being subjected to a force at its concavity, tending to increase its curvature. Very possibly, this leverage may have something to do with some fractures by indirect violence, as when a man falls forward on his outstretched hand, and the scapula is driven backward, carrying with it the acromial end of the clavicle. And I believe it affords the true explanation of those cases in which the clavicle gives way to muscular violence, as in striking a blow with a whip at a dog, or pulling down the brace of a carriage-top. In these and all the other recorded instances, the action was such as to forcibly and suddenly depress the outer end of the bone.

The other point of which I would speak is the mechanism of the displacement in fractures of the clavicle. With regard to this, most authors simply say that the weight of the shoulder causes it to drop; and in a recent paper by Mr. C. W. Cathcart, published in the BRITISH MEDICAL JOURNAL for August 30th, this view is discussed at some length. He argues that the weight of the shoulder is not normally supported by a strain on the shaft of the clavicle, but that, as pointed out independently by Cleland and Duchenne, the shoulder is really suspended in position by the action of the trapezius muscle. The traction, he thinks, is not direct, but to a certain extent indirect, the clavicle acting as a lever, with its fulcrum at the sternoclavicular joint. In a later paper (published on October 25th), he speaks of the bone as acting like the oblique beam of a crane "in supporting the weight of the arm"; and says that the "thrust" from within is lost when the bone is broken. Now it seems to me that in this last phrase he gives a more significant fact than he himself perceives.

I question whether the weight of the arm is in any material degree

supported upon the clavicle; but this would be a matter requiring a good deal of space for its discussion; and I would merely suggest that when the clavicle—a purely "intermediate" bone—gives way, the muscles, which are the real agents of suspension, are as a general rule unimpaired. There must be some other reason for the downward, forward, and inward displacement so uniformly met with; and such a reason, I think, may be found in the action of certain muscles.

As soon as the integrity of the clavicle is lost, the serratus magnus and pectoralis minor rock the scapula forward around the thorax, while the rhomboideus major tilts its lower angle upward. Hence the acromion is lowered and moved toward the median line anteriorly, pushing the outer fragment of the clavicle before it. Should the line of fracture be just within the insertion of the subclavius, this muscle would tend to act in the same way, drawing the outer fragment toward the sternum; but this would, in most cases, be only a trifling accessory. The effect above described can be produced by the serratus magnus and pectoralis minor, and by them alone; nor is it opposed by any of the other muscles of the shoulder.

Very striking confirmation of the view now stated is afforded in the account given by Malgaigne of a patient of his who had an ununited fracture in each clavicle.

"Both clavicles had been broken at the middle; the two inner fragments were nearly horizontal, and very distinct beneath the skin; the outer fragments had also a nearly horizontal direction, but were buried behind and below the others, to which they seemed to have no adhesions of any kind. The overlapping was considerable..... Posteriorly, the scapulæ were separated from the spinal column by three or four inches, and inclined forward and outward; and on the whole the thorax seemed much contracted at its upper part.

"He could draw the shoulders back a little, but not enough to overcome their apparent prominence anteriorly. On the other hand, he could draw them together forwards, so that they seemed like wings covering the chest, and leaving between them, in front of the sternum, only three inches' space. In this movement, the scapulæ fitted to the sides of the trunk, and the back seemed rounded from one side to the other, almost like that of a skeleton deprived of its upper extremities" (*Traité des Fractures*, etc., tome i, p. 496).

At the time (1866) when I first published this view, I was not aware that it had been already advanced by Professor Gordon, of Belfast, in a communication to the Belfast Medical Society (see *Dublin Quarterly Journal of Medical Science*, November 1859). Nor was he probably aware of my statement of it when he, in 1875, issued his *Treatise on Fractures of the Lower End of the Radius, on Fractures of the Clavicle, etc.* Certainly, we neither of us succeeded in gaining the consideration which, as it seems to me, the correctness of the theory deserved.

Now the practical bearing of the explanation above given is by no means unimportant. Restore the scapula to its position, and the outer fragment of the clavicle is also drawn into place. It is useless to push up the shoulder, and to put pads in the axilla, and to bring the elbow forward and inward. The scapula itself is the thing to be acted upon. For this purpose, the best apparatus yet devised seems to me to be that of Dr. Sayre, of New York, consisting of two wide strips of adhesive plaster, so applied as to draw the upper part of the humerus, and with it the scapula, toward the median line of the back. A detailed description of the method may be found in many works on surgery. Rest on the back for the first week or ten days, if submitted to by the patient, would be a valuable accessory to its efficiency.

EXPERIMENTAL RESEARCHES ON DIPHTHERIA.

Read before the Lancashire and Cheshire Branch.

By CHARLES J. RENSHAW, M.D., ASHTON-UPON-MERSEY.

I MADE the following experiments on animals, with diphtheritic membrane.

On June 1st, 1874, I administered membrane of diphtheria to one cat; on June 3rd, to two mice; on June 5th, to a rat; on July 2nd, to two cats; on August 7th, to a cat; on August 21st, to a cat; on September 3rd, to three mice; and on September 3rd, 7th, and 18th, to three hens. The result in all was negative. The membrane was of a yellowish white appearance. All the patients from whom the membrane was taken had enlargement of the lymphatic glands at the angle of the jaw, and three of the cases suffered afterwards from paralysis. Five cases had albuminuria, commencing on the second, third, fifth, and ninth days respectively. There was no doubt as to the membrane being that of diphtheria.

On June 6th, 1874, having seen that the stomach and bowels of a

cat were emptied, I administered some diphtherite of a whitish grey colour, taken from the throat of a living patient. The result was death from diphtheria on the seventh day. On June 6th I gave some to a second cat; the result was death from diphtheria in twelve days. On examining the first animal after death, I found patches of diphtheritic membrane on the mouth, fauces, and lining of the bronchial tubes, also on parts of the bowels. The small amount of urine I was able to collect from the bladder was highly albuminous, the kidney was of whitish colour. The second cat lived to the thirteenth day, having begun to be ill on the fourth, and suffered from a severe attack of the disease; the *post mortem* examination showing the diphtherite lining the whole mucous tract, partly in patches, from the mouth to the anus; the urine was albuminous, the kidney similar to what one meets with after death from scarlatinal dropsy.

On June 8th I administered diphtheritic membrane to a cat, death occurring on the ninth day; and on June 9th, to two mice; death occurred on the tenth and thirteenth days.

On June 10th, 11th, 12th, 13th, 14th, and 15th, I saturated some membrane, taken from the same case of diphtheria, in a solution of permanganate of potash, which gave negative results, on the administration to animals, in nine cases. I also got negative results from saturating the diphtheritic membrane in hypochlorous acid, and using it for a like purpose.

On June 12th, I introduced some of the diphtheritic membrane into the axilla of a cat by means of a wound; the animal began at once to be ill, and in three days there was membrane on the fauces and the back of the throat. The attack of the disease was slight, recovery soon taking place.

The fourteen experiments on animals with the yellowish white membrane were all failures. The six experiments on similar animals, made with greyish white membrane, were successful. All experiments on graminivorous animals were also unsuccessful.

What is the cause of diphtheria? Is diphtheria a sewer-disease? If not, how does it arise? I see in the deductions drawn by Mr. Shirley Murphy, from the papers of the Collective Investigation Society upon that disease, that less than one-tenth of the number of cases are supposed to arise from sewers or bad drainage. I at first thought the disease was met with chiefly in new houses and new drainage-areas. I find it is equally to be found in old as in new houses, well drained and otherwise, in houses in which there is no connection with drains, and in localities where there are no drains at all. It is, therefore, evidently not a sewer-disease *per se*, although it is, no doubt, possible for it to be carried by drains; and, undoubtedly, badly ventilated drains emitting noxious gases into the house of the patient make it a much more dangerous disease to treat. The disease is epidemic and sporadic, and, as far as I can make out, does not follow any particular line of drainage.

The following facts point to the disease being a ferment neither of decaying vegetation nor animal decomposition alone, but to a mixture of both. In the great epidemics of France (1818 and 1855) and Scotland, it is on record that the places were in an unsanitary state, all sorts of material, mixed and unmixed, animal and vegetable, being left about to decay and taint the air.

1. A heap of vegetable matter, on October 1st, was mixed with a quantity of animal matter by two men; both heaps had been on the ground for some months. Neither of the men were taken ill. This mixed heap was distributed over a field on March 1st. One of the men who distributed it, and a boy who assisted him, were taken ill of diphtheria, one on March 3rd, the other on the 7th. 2. A similar heap, similarly treated, was spread on a field adjoining a house in which there were children; the two men who carted the material on to the field, as also the five children, were all ill of the disease within fourteen days. 3. A heap of ordure, close to a house, having been there for a considerable time, was mixed with some vegetable refuse; no one was ill then, but three months afterwards, it being opened and used to the garden, four children residing in the house were seized with diphtheria. 4. Two children were playing on a heap of animal and vegetable manure, just opened; four days afterwards the first child was taken with diphtheria, and two days later the second child fell ill with the same malady. 5. Some strong mixture of blood and vegetable matter was spread on a rose-bed. A little child who watched the process was sick at night, and four days afterwards was suffering from diphtheria; there was no other case in the neighbourhood, and the child had not been out of its own garden.

Of 126 cases treated by means of stimulants and nourishment by the internal administration of tincture of perchloride of iron and sulphate of quinine, the painting of the throat by a saturated solution of permanganate of potash, and, where possible, the use of a hypo-

chlorous acid gargle, together with the removal of the false membrane, where such could be done, there were only seven deaths. The following cases will show the general character of those treated.

CASE I.—Mrs. M., aged 33, well made and healthy, suckling her seventh child, commenced to shiver on November 1st at bed-time; on November 3rd, she complained of stiffness of the lower jaw and sore-throat. The pulse was 130, temperature 102°, tonsils swollen, deglutition difficult, respiration 28. Eight hours later, the diphtheritic exudation appeared on the tonsils, and twenty-four hours later, ninety-six hours from the probable time of contagion, the whole of the back part of the mouth was covered with diphtheritic membrane; the pulse was 160, temperature 106°. The membrane increased so much in thickness, that there was danger of mechanical suffocation; the effluvia was most offensive. The patient recovered after a struggle of four weeks. At the outset of the disease, six ounces of brandy and as much champagne as possible in the twenty-four hours, beef-tea made with barley-water, turtle and ox-tail soup, were given. The tonsils and other affected parts were freely painted with a saturated solution of permanganate of potash, the membrane was removed morning and evening for eight days, and quinine was given till the temperature fell to 101°, and then it was combined with tincture of perchloride of iron. Albuminuria appeared on the second day of the formation of membrane; and, although much relieved, was still present, three years since the attack. At the end of six weeks, paralysis first attacked the eyes, causing internal strabismus, then the nerves of hearing, then of smell, then of the throat, chest, arms, and legs; it was treated by the internal administration of strychnine and the use of the constant current; recovery was perfect.

CASE II.—L. M., female, aged 23, fairly healthy, had a severe rigor on June 24th; on June 27th, the membrane showed itself on the fauces, and rapidly spread, covering the mouth, and apparently passing down the air-passages and oesophagus, as there was difficulty in breathing and swallowing.

On June 30th, there was double pneumonia, the abdomen was tympanitic, and the mucous membranes of the rectum, vagina, and lower part of the uterus were covered with diphtheritic membrane. The following day she died. I was unable to remove the membrane from the mouth, as I could not get the mouth sufficiently open. A nourishing and stimulating method of treatment was ordered, but my recommendations, I afterwards heard, were imperfectly followed out.

CASE III.—L. K. shivered on June 6th, having visited a relative suffering from diphtheria on the 1st. On the 8th, there was diphtheritic membrane over the soft palate, which spread over the roof of the mouth and lined each cheek. By the 11th of August, he recovered, after a severe attack of paralysis.

CASE IV.—C. J., female, aged 23, had an attack of shivering on August 1st. Diphtheritic membrane appeared over the back of the throat and roof of the mouth on August 5th. Recovery took place after seventeen days. There was no paralysis. The supposed cause was bad smell from a mixed manure-heap.

CASE V.—M. B., male, aged 11, mixed some manure on September 1st. He was taken ill on September 9th. A diphtheritic membrane appeared on the throat, cheeks, and the roof of the mouth on September 12th. Recovery took place, without paralysis, after fourteen days' illness.

It is a well known fact that scarlet fever and diphtheria may affect the patient at the same time; and Dr. Ransome, in his excellent pamphlet on the "Relations between Diphtheria and Scarlatina," suggests a strong connection between the two diseases, and throws out the idea, that the difference lies in the difference of ferments; this is a valuable suggestion, which leaves large scope for inquiry and experiment.

It is not, as you are aware, an uncommon occurrence for a patient, suffering either from scarlet fever or from diphtheria, to be seized with epistaxis. I was able to try the effect of injecting the liquor sanguinis from both cases into animals. That from scarlet fever, injected into the areolar tissue of a rabbit, caused slight illness on the second day, sore-throat on the fourth, and whitish tongue on the fifth, sixth, and seventh, with recovery on the tenth. The liquor sanguinis from a case of diphtheria caused death, in a rabbit similarly treated, seventeen hours afterwards, from congestion of the lungs, and in a frog awakened from its hibernation in twenty-four hours. I made some experiments with the membrane of membranous croup, by administration to animals, but I was unable to find any effect.

It would seem, from the above named experiments, that diphtheria is different from membranous croup; that it is different from scarlet fever; that it is a disease of itself, of a highly dangerous character, but that science has great power over it as to prevention and treat-

ment. It is conveyed by contagion, and may also arise *de novo*, from, I believe, a mixture of animal and vegetable matter in decomposition under certain circumstances; but there is little, if any, evidence to show that it is caused by sewage simply, or by animal or vegetable decomposition alone.

EXCISION OF THE RECTUM.

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MUCH has been done, of late years, in the way of improving and perfecting the operation of excision of the rectum; and yet many surgeons are doubtful of its advantages, and prefer either inguinal or Callisen's colotomy. French surgeons, in particular, have had untoward results; and, with loud voice proclaiming their disapproval of the radical method, have advocated various modes of alleviation and compromise. The Germans, on the other hand, foreseeing the advantages likely to accrue, have quietly set themselves to render it easier of performance, safer from risk, and more satisfactory as regards the conservation of the action of the sphincter. In England, the name of Harrison Cripps is well known in this connection, and his researches into the nature of the stenoses and obstructions in this region have led to a more scientific discrimination of the cases fitted for operation.

"Whether excision or colotomy," is a question which must be mainly settled in each individual case; but I venture to formulate the following rule: that when the finger, pushed through the stricture, reaches the upper limit of the ring, or mass, *in front*, excision, and not colotomy, should be resorted to. When the disease extends higher, each case must be decided on its own merits; but of this there is no doubt, that colotomy is not, even in the best hands, a safer operation than extirpation. Indeed, statistics (according to Bryant) are more favourable for the latter operation. The advantages of colotomy are ease and rapidity of performance, as well as an absence of disease in the tissues cut through. *Per contra*, there is the danger of setting up peritonitis, cellulitis, etc. There is also the inconvenience of having the opening into the bowel in an unnatural situation; and, when all has been done, the disease itself is left. Extirpation is more tedious and difficult; but it has the great merit of being an attempt, at least, to remove the disease radically; the anus is retained in its normal position; and considerable, if not at all times perfect, sphincter power remains.

There are several ways of performing this operation, the later modifications aiming at the preservation of the sphincters. Where the anus and skin are much involved, it is common to make a circular or elliptical incision, so as to include all the disease, to separate the mass from its connections in the pelvic outlet, divide the bowel above the affected part, and stitch it to the integument. In annular strictures, an ano-coccygeal incision may suffice, though it is not a good one in most cases. Hüter of Greifswald recommends a horse-shoe incision (Fig. 1), the curve of the shoe encircling the front of the anus, and the ends terminating in the ischio-rectal fossæ. The flap thus formed is thrown backwards with half an inch of rectum, to be replaced after removal of the disease, and the two pieces of bowel are stitched to each other. In the case to be related, I adopted an incision as in Fig. 11. Here the curve extends round behind the anus, and the

Fig. 1.

Fig. 2.

limbs, passing forward and well outward, terminate considerably to one side, and a little in front, of the bowel, and, from the centre of the convexity, a straight cut is carried backwards over the dorsum of the coccyx and sacrum.

Cancer or cancerous stricture is the disease for which excision is most frequently required. In cicatricial stenosis, the bougie or incision, followed by dilatation, is the practice usually followed, or the linear rectotomy of Verneuil; but, "in all cases," Bryant remarks, "there comes a time when treatment by dilatation ceases to be beneficial." He then proceeds to recommend colotomy. Why not excision? In the following case it had, unfortunately, been delayed rather too long.

A. M., aged 37, had for nineteen years suffered from fistulæ *in ano*, and, though twice operated upon, they did not close. Nine years ago, Mr. Brewer of Huddersfield found him suffering from stricture of the rectum. Since then, he has had little peace or comfort, suffering much from irritation and inflammation in and around the bowel; narrowing

and flattening of the extruded fæces, if constipated; or acrid liquid discharges, mixed with small scybala. During the last twelve months, when under Dr. Hanson of Huddersfield, the symptoms, though alleviated as much as medical treatment could, latterly became aggravated; and, when he came to be examined, he was worn and a good deal wasted with pain and anxiety about his state. Obstruction had become worse, and defæcation more difficult and exhausting. There were two fistulæ discharging matter near the anus—one opening through an old abscess, and the other directly into the rectum. The finger could with great difficulty be pushed through the stricture, which commenced half an inch above the end of the bowel, and the finger-tip just reached its upper limit in front, where it ended rather abruptly. Behind, it extended higher; the passage was crooked, but the lining felt healthy, and there was no approach to nodulation, while a tough mass of cicatricial tissue filled the whole pelvic outlet.

The patient's weakness was the only indication against the operation, and it did not seem to be extreme; and, as he was aware his life could not be much prolonged, he was anxious to go through whatever was deemed fit. Extirpation was decided upon, and carried out with the assistance of Dr. Hanson, Dr. Coutts of Waterfoot, and Mr. Macnab of Hull. An incision was made as in Fig. 11, and the flap dissected forward with half an inch of rectum. A straight cut was next carried back over the dorsum of the coccyx, which was separated by a bone-pliers. The mass was then separated from the front of the sacrum, peeled off the obturator internus muscle, and, with a catheter in the bladder, to indicate the position of the urethra, the separation was completed in front by the *écraseur*. The dissection was done in the main with the finger, with occasional aid from Richardson's saw-scissors. The mass, being now loosened all round, dropped down, bringing into view a healthy but muscular rectum, crossing the anterior surface of which was a distinct white line, marking the reflection of the peritoneum. A surprising amount of healthy rectum lay between this and the diseased mass—about an inch. The atmospheric pressure had carried up the recto-vesical pouch, in the same way as Sims' speculum acts in vaginal examinations. The *écraseur* divided the bowel without hæmorrhage; and, in fact, very little blood was lost at any stage, two small perineal branches only being secured. The stitching together of the two pieces of bowel proved a troublesome operation, the more so from the section of the bowel being rather oblique. Drainage-tubes were then introduced, and the external incision closed.

The patient revived wonderfully after a very tedious operation, and in the evening seemed quite lively; but the pulse was small and rapid, beating at 120. Next day, he kept up well. The pulse, however, did not moderate, and the thermometer stood at 100.5°. This was the highest temperature reached. On the morning of the second day, he was very weak and collapsed, and hiccough had proved troublesome all night; the temperature of the extremities was low, and a cold damp moistened the skin. The wound was healthy-looking, but inactive, and the discharge rather copious, and of a serous nature. In the evening, he remained in much the same state, the hiccough being still very harassing. The third day found him much worse, and about noon he was evidently sinking. He died seventy-two hours after the operation.

The cause of death in this case was evidently shock, reaction having been weak from the first. Had the patient made up his mind sooner to have "something done," there is considerable reason to believe the result would have been different, and it is questionable if colotomy would have been more successful.

The incision employed in this operation has, I think, certain advantages over Hüter's. It is more suitable for the removal of the coccyx, which is a considerable gain in a case like the above, where a large mass has to be taken away; and I am not aware that the absence of the bone in question is in any way detrimental. Professor Esmarch of Kiel makes an excellent suggestion in this connection. He recommends that the lower piece of bowel should be removed altogether, and that the upper portion should be stitched to the margin of the anus. This is an improvement in more ways than one. By drawing the bowel through the central opening of the flap (anus), the process of stitching is transferred from the inner to the tegumentary surface, rendering it easy, and uncomplicated with numerous long threads. But of greater importance than this is the advantage in healing. When the two pieces of bowel are stitched above the anus, we have a circular wound, through which the bowel-contents have subsequently to pass; and, unless it heal quickly by first intention, which it rarely does, the connection is broken the first time the bowels are moved, and the fecal matter finds its way through the wound, causing a fistula, which is a long time in closing. I had an experience of this sort, where an annular stricture was removed through an ano-coccygeal incision. The bowels could not be kept constipated for more than five days, and