come from the cells, since little or none had been given by the mouth, and that the water in the cells had been responsible for the high blood pressure. An opposite state of affairs would appear to have taken place between February 24th and 27th. The oedema subsided and the blood pressure rose. Apprehensive of further convulsions, the uterus was emptied on February 27th. The increase in the albuminuria during the same period is also significant.

Allusions are to be found in the literature to the similarity of the convulsions of eclampsia to those produced in animals by the continuous forced administration of water. Rowntree and his co-workers²⁰ discovered and investigated this latter phenomenon and termed it "water-intoxication." It is characterized by a positive water balance, but this is correlated with an alteration in the sodium or base balance which results in a lowered amount of sodium in the plasma. Recovery from "water intoxication" convulsions in animals is very rapid by the use of intravenously or intraperitoneally administered hypertonic sodium chloride solution. The observations in this paper show a complete contrast in the action of hypertonic saline on eclampsia compared with "water intoxication" in animals. Moreover, Stander, Eastman, Harrison, and Caddan²¹ have shown an increased amount of base in the plasma of eclamptics. This again is in contrast with the findings in "water intoxication" in animals. It would appear that, despite a similarity of the convulsive states in the two conditions, and that changes in the water balance are probably involved in both, a clear distinction must be made. McQuarrie,²² in his recent studies on epilepsy, has drawn attention to its similarity with eclampsia, as well as "water intoxication." According to the author the use of urea among other measures acts as a preventive against the seizures of epilepsy. Harding and Harris²³ have recently in-

vestigated the influence of urea solutions in "water intoxication" with negative results, and are thus inclined to dissociate it from epilepsy. Whether urea will be of value in the treatment of eclampsia and pre-eclampsia remains to be seen.

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FRACTURES OF THE PATELLA.*

BY

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MANY years ago a London woman sustained a fracture of the patella; John Hunter records how, after months of treatment, the knee-joint presented the dual problem of extension limited by powerlessness, and flexion limited by stiffness. Two hundred years have elapsed, but we are still faced with Hunter's problem; the keynote of the treatment of injury of the extensor apparatus of the knee, whether it be an avulsion of the quadriceps, fracture of the patella, rupture of the ligamentum patellae, or separation of the tibial tubercle, is the restoration of extensor power without impairment of flexion movement.

Although fracture of the patella was one of the first bone injuries to come within the scope of operative treatment there are still many differences of opinion. Is operation essential? Should the bone be drilled and sutured, or is it sufficient to suture the quadriceps expansion? Which is the best method of bone suture, and the best suture material? Is splintage also necessary? When should movements be commenced? Is manipulation necessary?

Hitherto these questions have been considered purely from the point of view of bony union, but if our objective is not simply union of the fracture, but restoration of the joint to normal, and we also consider the recovery of flexion movement, different indications arise. It may be true that immobilization of a normal knee does not cause permanent stiffness, but if a knee-joint is injured, and particularly if an arthritic knee-joint is injured, the inevitable penalty of prolonged immobilization in extension is some degree of permanent limitation of flexion. It follows that fractures of the patella demand sufficiently

firm operative fixation to render external fixation unnecessary; this is particularly true of the elderly patient. Early movement is essential, and a bandage applied firmly enough to prevent haemarthrosis gives all the post-operative fixation required. The actual date when movements are instituted must be governed by the success of the operative fixation. It is my own practice to test this by flexing the knee before stitching the skin. If the fragments are firmly held, assisted movement is commenced the following day. If the fracture is comminuted and fixation imperfect, movement is deferred until the fourth week, and is preceded by gentle flexion of the joint under anaesthesia deep enough to ensure perfect relaxation of the quadriceps. With a fully relaxed quadriceps manipulation is quite safe during the first four weeks. Within that time the adhesions are still light, they offer no resistance, and give way by the mere action of gravity unaided by any pressure on the part of the operator. On the other hand, I regard manipulation at any time between the fourth and twelfth weeks as very unsafe. The fragments are not yet firmly united, and the adhesions are now so firm and resistant that even the strongest suture material is liable to stretch or snap and allow separation of the fragments. Manipulation which is deferred longer than four weeks should be postponed until there is clear evidence of bony union of the fracture.

Operative Methods.

If the necessity for early movement is accepted it becomes obvious that operation is essential, that the bone must be sutured as well as the lateral expansion, and that the suture material must be strong. Catgut and kangaroo tendon are not sufficiently strong, and silver wire is notoriously unsafe and liable to snap (Fig. 1). Piano wire, on the other hand, is much less fragile, and its flexibility has the further advantage of allowing a knot to be tied. My own preference is for an absorbable material, and thick, braided silk has many advantages. It is extraordinarily strong, will withstand a much greater strain than the contraction of the quadriceps, and is sufficiently elastic not to snap; it can be secured in any length, is easy to work with, and can be tied in a knot which, owing to the roughness of the braided surface, will not slip. Lange has shown that

* A paper read in opening a discussion on fractures involving the knee-joint, in the Section of Orthopaedics at the Annual Meeting of the British Medical Association, Winnipeg, 1930.

within twelve months it is entirely converted into living fibrous tissue.

The method of inserting the suture is of considerable importance because the operation must not only prevent vertical separation of the fragments, but must also restore a smooth articular surface and prevent tilting of one fragment on the other. The patello-femoral joint is non-weight-bearing, but we know from the analogy of upper-

FIG. 1.

FIG. 2.

FIG. 1.—Old fracture of patella, operated on elsewhere, and illustrating the fragility of silver wire. The snapping of the wire has allowed wide separation of the fragments, complete loss of extensor power, and secondary backward subluxation of the knee-joint.

FIG. 2.—Fracture of the patella the day before (a) and the day after (b) operation, and fixation by silk suture. Knee movements were commenced the day after operation, and in eight weeks there was both bony union and full flexion movement.

limb joints that the constant movement of rough, irregular surfaces will produce arthritic change, even in the absence of weight bearing. Approximation should therefore be absolutely accurate; by fitting the fragments carefully together not only is fixation augmented and union accelerated, but osteo-arthritis is avoided. For this reason the more quickly operation is performed the better, and the practice of delaying operation for ten or fourteen days to allow the absorption of extravasated blood must be relegated back to the days of unreliable asepsis. I usually drill each fragment horizontally, and use two pieces of thread passed in opposite directions so that they can be tightened simultaneously on either side of the bone. This allows a much more accurate and close approximation than a single suture, which is tightened on one side only (Fig. 2). Accurate centring of the drill holes will usually prevent tilting of the fragments when the suture is tightened, but if it is feared that tilting may recur during the early days of movement a square stitch may be used

FIG. 3.—Methods of suturing fractures of the patella, a and b by encircling suture, which may allow tilting of the fragments, and c and d by a square stitch, which ensures a perfectly smooth articular surface.

(Fig. 3) in which the two horizontal strands prevent vertical separation, and the two vertical strands prevent tilting.

After-care.

The objective of early movement demands rapid healing of the wound. Forty-eight hours' skin preparation, complete screening of the skin at operation, "no touch" technique, and careful skin suturing are all essential. The C shaped incision should never be used. I have seen three cases

of sloughing of the apex of the inverted flap, and, apart from the risk of infecting the joint, a deplorable stiffness has resulted from the scar tissue formation and the enforced immobility.

Recovery cannot be regarded as complete until the quadriceps is fully redeveloped. For this purpose the most complicated of gymnastic machines and of electric batteries cannot equal the patient's own efforts. During half an hour of physiotherapy a masseuse may stimulate a quadriceps muscle fifty or sixty times. What is that to compare with the constant contraction of postural tone? The valuable time of the masseuse should not be occupied in gently lulling the patient to sleep with massage, but in rigorously goading him into activity, teaching him to regain his own mastery over the inactive muscle, and showing him postural and resistance exercises which can be practised, not for thirty minutes, but for the whole of his ten or fifteen waking hours.

AVULSION OF THE LIGAMENTUM PATELLAE.

So far no reference has been made to the use of fascia lata, and my own feeling is that it is an unsatisfactory suture material for the perfect approximation of two loose fragments, not simply because it is difficult material to work with, but because it is so elastic that early movement causes "springing" of the fragments, and one loses the perfect fitting together which operative treatment permits. On the other hand, it has an excellent application in the repair of avulsion of the ligamentum patellae from the lower pole of the patella.

In this injury the intact patella is pulled away from the ligament and is displaced up into the thigh by the tonic contraction of the quadriceps. It is notoriously difficult to suture the vertical ligamentous fibres to the bared lower pole of the bone, which is held up in tension. It may be quite impracticable, and instead of suturing the patella to the ligament it must be anchored to the tibia in some other way. The fascia lata already has a tibial insertion, and it is a very easy matter to take a strand from its thickened anterior margin still attached by one end to the tibia, pass the other end through a drill hole in the apex of the patella, and pull on it until the bone is down to its normal level. The fascia may then be stitched to itself through a tunnel in the tibia (Fig. 4). Sufficiently firm anchorage is given to the quadriceps and patella to allow repair of the ligament despite early flexion movement, and, provided that the patella is at a normal level, perfect function results even although there is frequently extension of ossification into the upper part of the ligamentum patellae.

FIG. 4.—Operation for repair of avulsion of the ligamentum patellae from the lower pole of the patella. A strand of the anterior margin of the fascia lata, still attached to the tibia, is passed through the lower pole of the patella and stitched to itself through a tunnel in the tibia.

AVULSION OF THE QUADRICEPS.

Exactly the same injury may occur at the upper pole of the patella, and the whole bone may be torn away from the quadriceps insertion. The injury is not a common one, and my own series includes only five cases, of which one was bilateral. It is frequently overlooked because at first there is no x-ray change. The clinical signs, however, are exactly those of fracture of the patella, and an even more serious disability arises in untreated cases.

The injury involves mainly the insertion of the vastus internus and the crureus, and the muscles detach the aponeurotic covering of the patella with an underlying layer of bone cells. Within a few weeks new bone is

deposited, and, since the muscles retract, ossification may occur above the patella for two or three inches. Subsequent x-ray examinations show gradual condensation of

FIG. 5.—Case of avulsion of the quadriceps treated conservatively by immobilization of the knee on a back splint. *a*, One day after injury. *b*, Four weeks after injury. *c*, Two years after injury. Despite immobilization, the quadriceps has retracted and its lower two inches is ossified. Better results follow immediate operative repair.

the new bone and all the changes characteristic of myositis ossificans. If the knee is immobilized in extension the new bone may remain attached to the patella (Fig. 5); but if without first suturing the aponeurosis forced passive movements are carried out, the bone cells are still further separated from the patella, and large masses of free bone are produced (Fig. 6).

FIG. 6. — Untreated case of avulsion of the quadriceps, with resulting ossification above the patella. Note the resemblance to myositis ossificans.

The term "myositis ossificans" of the quadriceps is an entire misnomer; the process is purely traumatic and mechanical, and in no sense inflammatory. Far from being an inevitable complication of knee injuries, it is entirely avoidable by suturing the quadriceps back to the bone. It must be equally true that many of the cases of myositis ossificans of the elbow are simply mechanical in origin, due to avulsion of the brachialis anticus, and preventable by securing reattachment of the muscle to the coronoid process, whether by conservative or by operative treatment.

A MODIFICATION IN TRACHEOTOMY.

BY

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My object is to place on record the application of a well-known manoeuvre in a manner that does not appear to have been described previously.

Progress in anaesthetic practice has made endotracheal catheterization a commonplace. The work of Rowbotham and Magill¹ on the passage of the endotracheal catheter via the nasal cavities revealed unsuspected possibilities; and that of Magill² on the passage of the endotracheal catheter via the nose *without the assistance of vision* has further widened the application of this useful manoeuvre.

The introduction of endotracheal catheters via the nose, a proceeding that has proved most helpful in anaesthetizing patients with conditions such as trismus, has hitherto been performed after the induction of general anaesthesia; and it was obviously merely a matter of time before its potential advantages would point the way to the introduction of catheters via the nose under local anaesthesia. The occurrence recently of a respiratory emergency in the throat department of St. Bartholomew's Hospital provided an opportunity for the testing both of the possibility of the manoeuvre and of its usefulness. The history of the case is as follows.

W. D., aged 69, a big burly man with a short thick neck, was seen on June 24th suffering from severe dyspnoea with stridor, due to an intrinsic laryngeal carcinoma. A satisfactory laryngoscopy was not achieved owing to the intolerance of the patient, and to the fact that alterations in the position of the head increased the dyspnoea to an alarming degree. It was decided to perform a tracheotomy at once. The shape of the patient's neck and the intensity of the dyspnoea rendered tranquil tracheotomy problematical; and laryngotomy was contemplated as being more practicable, at any rate as a preliminary. General anaesthesia appeared to be contraindicated.

It was thought worth while to try to intubate the larynx via the nose before actually beginning the incision; and after cocaineization of the nose with a spray, the operator attempted the intubation, while the assistant held himself in readiness to perform an immediate laryngotomy if the intubation should fail. A No. 12 Porgés catheter mounted upon a stylet was successfully passed at the first essay; and after a short bout of coughing the delighted patient, speaking hoarsely round the tube, exclaimed, "This is pure Heaven! I'll remember it all my life"—not an overstatement, in view of his age and the condition from which he was suffering.

A low tracheotomy was then performed in a leisurely manner, and with an entire absence of the anxiety which usually assails the patient (and not infrequently the surgeon) during an operation of this type on a cyanosed patient with a short neck. The venous bleeding which might otherwise have been expected was noticeably absent. It turned out that the tracheal rings happened in this man to be partially calcified, and that removal of the necessary piece was somewhat difficult—a fact which would probably have intensified the difficulties of tracheotomy by the ordinary method. The coughing which usually follows upon the first perforation into the tracheal lumen was absent, because of the cocaine previously inhaled.

DETAILS OF THE METHOD.

It would seem that a great advantage in the nasal route is that while a patient suffering from dyspnoea is intolerant of any approach via the mouth, he does not resent the introduction of an innocent-looking tube into his nostril; and, provided the nasal passage and pharynx have been rendered moderately anaesthetic, he does not appear to be distressed by any groping for the larynx which may be necessary. The anaesthesia is achieved quite quickly by spraying via the nasal passages (not the mouth) during inspiration with a solution of 10 per cent. cocaine hydrochloride to which a drop of adrenaline 1 in 1,000 has been added; and the patient as a rule derives some immediate relief from the shrinking and numbing of the laryngeal mucosa. While it is a fact that a tube passed via the mouth is more likely as a rule to find its way into the oesophagus, this seems not to be the case when the nasal route is employed. The tip of the tube is usually tilted slightly forward by the cervical vertebrae, and so tends to arrive anterior to the opening of the oesophagus. If the usual bulge forward of the cervical vertebrae is lacking, the catheter point can be bent forward upon the stylet so that it presents at the larynx.

The diagram indicates the shape of catheter that was employed; but I gather that anaesthetists prefer to employ a soft rubber tube of large bore for routine use (upon patients already induced), relying upon the natural curve which is always present in such a tube, and upon small-range extensions and flexions of the patient's head to bring the tube opposite the glottis; so it may be that a soft tube might also be coaxed into the trachea even if stridor were present.

POSSIBLE APPLICATIONS OF THE METHOD.

The value of this procedure was striking in this particular case, and opens up interesting speculations as to the degree of its general utility. It should be profitable to explore its possibilities in two distinct directions: first, as