ON TORSION OF ARTERIES ;

WITH AN ACCOUNT OF SOME EXPERIMENTS ON THE DEAD SUBJECT AND ON ANIMALS.*

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ON a former occasion, when I had the honour to deliver an address before this Association at the sister University, I expressed my belief that the ligature is the most important addition ever made to surgery. Still, I added that, forasmuch as it does necessitate a slight amount of sloughing and suppuration in the wound, I should be glad to see this good thing superseded by a better. Indeed, the advantages of an early healing of wounds after operations, and under other circumstances, are so incalculably great, that we are bound to try every reasonable expedient to promote it; and, assuredly, we cannot yet feel that this branch of our science is freed from the opprobrium under which, unfortunately, it has always been. How terrible has been the mischief that erroneous theory, with its sure attendant, vicious practice, has contrived to work in the treatment of wounds; and, so long as the question is still asked, and not satisfactorily answered, Do you ever see an amputation-wound heal by first intention? it is a shame to us to rest content. The tendency of recently cut surfaces is to unite at once if they be merely kept in apposition; and, when they do not unite, the cause, in most instances, is to be found in a want of attention to this simple requisite. A reckless disregard of this was the disgrace to the surgeons of old; and we have not altogether lost the tendencies inherited from them.

It was the desire to free the wound still further from obstacles to the union of its surfaces, that induced me last year to try the method of acupressure so ably and energetically advocated by Sir James Simpson and the surgeons of Aberdeen. I found it to answer the purpose of arresting hæmorrhage sufficiently well;† but it had the disadvantages necessarily attendant upon the presence of a number of needles left in the wound, and requiring to be withdrawn a few hours after the operation. I determined, therefore, to make a trial of the practice of torsion recently introduced into more general notice by another of our northern associates, who has done so much for the advancement of surgery; and I trust a few observations upon the subject may not be unworthy the attention of this meeting.

The principle of torsion is much the same as that of the ligature. In both, the thick, musculo-elastic, inner coat first gives way, and its cut or torn edges are pressed together and held in contact by the more resisting outer coat, which is bound upon them by the ligature, or coiled upon them by the torsion, so that they have an opportunity to unite and seal up the end of the vessel. The success of each method depends upon the difference in the physical characters of the two coats: upon the tough resisting quality of the outer coat, and upon the lacerability and the adhesive tendency of the inner coat.‡ When the divided end of an artery is seized with forceps held in the direction of the axis of the vessel, and is twisted, the inner coat soon gives way under the forcible compression, and is torn through more or less abruptly; that is, more or less, as if it had been divided by a ligature or knife. This takes place, usually, just above the grip of the forceps; for, though the twisting affects the vessel higher up, it is sharpest here; and it takes place before the outer coat begins to give way. The fibres of the latter are thus far simply twisted together. As the operation proceeds, these also gradually give way, leaving a pointed end composed of the torn threads of the outer coat, so closely compressed together that they remain in this condition, sealing the vessel, and holding in contact the lacerated edges of its inner coat.

But a further result usually follows from the difference in the resisting quality of the two coats. Not only is the inner coat torn through, as just mentioned; but, during the subsequent twisting and the compression to which it is thereby subjected, it becomes detached from the outer coat, or it does so in the greater part of its thickness, and is turned upwards—that is to say, reflected—so as to form a valve or inverted funnel directed towards the heart and resisting the blood-current. The forma-

tion of this funnel, which has been well described by Mr. Bryant,* is especially well seen in some of the lower animals—the bullock, for instance—where the coats of the arteries are strong, and where the inner coat is thick and admits of comparatively easy separation from the outer coat. It may also be often well seen in the artery of man. This reflection of the inner coat affords an additional security; but I do not attach to it so much importance as a barrier to the flow of blood as I do to the twisting of the outer coat; forasmuch as by this the inner coat is not only forced into, but is held in, its new position. Accordingly, if a syringe be attached to an artery thus twisted, and water be injected, considerable resistance to the escape of the water is presented; but, if the twisted portion of the outer coat be cut through or dissected off, the water very soon escapes. It has little difficulty in finding its way through the inner coat, or of separating the surfaces when the support afforded by the outer coat is withdrawn.

When water is thrown from a syringe into a twisted artery, if sufficient force be used, it passes the inner coat, insinuates itself between the two coats, and finally makes its way through the outer coat. I tried also with mercury, making many experiments on the human body and on the bullock, to ascertain the height of the column that would be borne by a twisted artery, and to determine what is the best mode of performing the operation. I found that the well twisted carotid or femoral artery of a man will generally bear a column of from twelve to twenty inches of mercury; but that sometimes, although I performed the torsion, as I thought, in precisely the same manner upon the same vessels, the metal escaped under a lower pressure; that, in short, I could not be sure of so twisting a large artery as to enable it to bear a column of more than a few inches. In arteries above this size—the innominate, common iliac, and, especially, the aorta—the result was less satisfactory, which, I think, might be anticipated, from the greater proportion which the elastic or brittle tissue bears, in those vessels, to the other components of the arterial tube, and still more from the large area which has to be covered and closed, and the great lateral distending or stretching force upon the puckered sides of the vessel, which has to be resisted by the comparatively thin twisted outer coat.

The mercury first distends the end of the vessel just above the twist, and, by its pressure, to some extent, untwists it. It then traverses the funnel-shaped aperture of the inverted inner coat, and passes beneath the twisted outer coat. A comparatively slight pressure sometimes suffices to carry the mercury thus far; and the resistance to the escape of the fluid after this depends entirely, of course, upon the outer coat. The mercury distends it, and, as the pressure increases, either finds its way through some weak point, where it forces a small aperture; or the coat gradually untwists till the mercury escapes through the extremity or point of the twist. Where the outer coat is strong, and has resisted the torsion well, so as to be drawn into a long twisted end, the column sustained is highest. But why, in some instances, the resistance was less than in others, I could not tell. Further observations may explain this, and afford some hints for a better mode of performing the operation. The resistance was evidently almost entirely due to the twisting of the outer coat, being caused partly by the compression which it exerted upon the displaced inner coat, but still more by the direct obstacle which it presented to the escape of the fluid. I found, accordingly, that a complete twist affords the maximum security; that is to say, the artery bears a higher column when its end has been quite twisted off than when this has been only partially done.

The forceps should not be toothed or sharp at the edges, so as to tear or cut the outer coat. They should be broad enough to include the whole, or nearly the whole, of the vessel, when it is flattened out under their grip; and it is a great convenience that they should be easily clamped when the artery is seized, so as to hold it well during the twisting. Beyond this, I do not think it is very important what kind of forceps is used. I have often employed a pair of needle-nippers, with the edges a little blunted and the corners rounded off, and have found that they answer very well.

When the artery was held with a second pair of forceps above the part twisted, so as to limit the extent of the twisting upon the vessel, the result was not so satisfactory. The sealing of the vessel was not so effectual; and the damage done to the coats of the artery by the firm pressure of the forceps requisite to prevent its rotation, was as great as that done by the rotation. This rotation of the artery upon its axis takes place for some distance above the part seized by the twisting forceps when the operation is commenced. Usually, however, the coats immediately above the forceps give way; and the artery above, unfurling itself, tends to complete the twisting and tearing through of the coats near to the forceps. It may happen that the vessel gives way, and undergoes more complete torsion higher up at one or more places. This would, prob-

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† I used acupressure after amputation in the thigh and other operations, and never experienced any secondary hæmorrhage; and I find that a femoral artery divided and carefully secured by this method will bear a column of twenty inches of mercury.

‡ Though more than two layers or coats are described by many anatomists in the wall of an artery, yet, practically, they may be considered as two—an inner thick, brittle, musculo-elastic layer, and an outer tough, resisting, fibrous layer.

* See also drawings of arteries subjected to torsion, in the *Journal of Anatomy*, vol. iii, pl. 1, figs. 2 to 7.

ably, not be attended with any particular disadvantage; neither do I think the rotation of the artery in its sheath likely to cause injurious effects.

When the ligature is used, a well tied artery bears a column of thirty inches or more of mercury. Experiment, therefore, shows, what we should expect, that the twist offers less resistance to the pressure of mercury in a vessel than does the ligature; very much less, if we take into account, as we must do, the minimum weight of the column sustained in some of the arteries which I tried. The ligature, indeed, offers much more resistance than is necessary; for the pressure of blood in the arteries in their full healthy condition does not amount to more than that of a column of mercury of six inches; and the question is, whether torsion can be relied upon to prevent the escape of the blood under the pressure to which it is subjected in the arteries. The experiments which I have made leave no doubt about this as a general rule, in the case even of vessels as large as the femoral and carotid. If a twisted vessel will bear a column of twelve or more inches of mercury, it will much more than withstand any pressure of the blood to which it can be subjected; and we may assume that most of those vessels which yielded to the mercury under a lower pressure, were sufficiently sealed to have prevented the escape of blood, especially if we take into account the contractile character of the arterial coat, the adhesive coagulating qualities of the blood, and the indirect route which the fluid must usually take to find its way through the twisted end of the artery—a circumstance unfavourable to the escape of blood, but offering no impediment to the passage of mercury. The question, however, can only be satisfactorily answered by experience of torsion in the living subject.

(To be concluded.)

CLINICAL MEMORANDA.

[Under this head, we shall publish from time to time, as materials accumulate, short records of remarkable cases in practice which are sufficiently rare, interesting, or instructive, to deserve record, but do not call for lengthened statement or comment. Brevity and point should be the valuable characteristics of cases forwarded for this column.]

DISLOCATION OF THE TENDON OF THE PERONEUS LONGUS MUSCLE.

By T. B. CURLING, F.R.S., Surgeon to the London Hospital.

A YOUNG gentleman, about twenty-one years of age, in May last met with an accident in jumping, by his left foot slipping on a stone and turning outwards. He felt considerable pain in the ankle, became lame, and sensible of something being wrong. On taking off his boot, he found a projecting cord at the outer and front part of the ankle; this he easily pressed back, with instantaneous relief. In the course of the following week, the displacement recurred twice; and the patient sent for Mr. Bailey, a surgeon at Wansford, who at once ascertained the case to be a dislocation of the tendon of the peroneus longus muscle. He applied an angular piece of cork to the margin of the fibula, so as to prevent the tendon from slipping over it; and confined this with a bandage. A few days afterwards, the patient called on me, when I found the tendon in its usual site, rather more prominent than usual. The cork pad was reapplied, and kept in place with strapping and a bandage; and walking exercise forbidden. After a few weeks, I had a laced-up ankle-support, with a pad to fit behind the fibula, made; and he was then allowed to move about, and he shortly returned into the country. He paid me a visit in December, seven months after the accident. He stated that the tendon had kept in place; but he occasionally felt a weakness in the part, and a sensation as if the sinew was not secure, especially in walking on rough ground. He was about to emigrate to Australia. I recommended his continuing to wear the laced-up sock and pad for some years.

Dislocation of the peroneus longus tendon is so rare an accident, that the particulars of a case are worthy of record. Two or three of my professional friends state that they have met with it, but I have no recollection of having read any account of it in books. The nature of the case can readily be recognised, and the tendon can be easily replaced behind the fibula. The great difficulty is to keep it there after rupture of the sheath, as the tendon so readily slips forward in the movements of the foot, which at once gives rise to lameness. This has caused so much annoyance, that it has been proposed to divide the tendon subcutaneously. In the above case, the tendon had been retained in place many months by great care on the part of the patient, who fully appreciated the difficulty of the treatment, and never moved about without the support of the bandage.

EXAMPLES OF CYST FORMATION IN THE NEIGHBOURHOOD OF THE FEMALE URETHRA.

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CASE 1.—In September 1867, I was consulted by a young married lady who had given birth to her first child six months before. She informed me that, when eight months advanced in pregnancy, a swelling appeared at the orifice of the vagina, which was not very sensitive to touch, but was attended by forcing pain, and a sense of something about to protrude. When labour came on, a soft tumour, like a small egg, was found attached to the neck of the bladder, and projected into the vagina. Although all possible care was exercised in supporting it during the passage of the foetal head, the pressure to which it was subjected had the effect of bursting it, and a quantity of thick fluid was discharged by the urethra. No further discomfort arose from it at that time, beyond some slight irritation of the bladder; but when she began to go about again, the swelling reappeared as before, and from time to time discharged a quantity of semi-puriform matter.

When I saw the patient, she was suffering much inconvenience from bearing down, with irritation of the bladder, and the urine was frequently mixed with purulent matter. She was conscious of some swelling at the vulva, but it was not very sensitive, and occasionally almost entirely disappeared. She had been wearing a round inflated India-rubber pessary, but found that it did not support or prevent the formation of the tumour. On examination, I found an elastic swelling, of the size of half a hen's egg, lying in the vaginal orifice. It was not unlike a cystocele, but was rounder in form, with a narrower base, and it was attached not to the bladder, but to the posterior part of the urethra. As I squeezed it, a mixture of urine and pus flowed from the orifice of the urethra to the extent of half an ounce, and the swelling collapsed. On passing a probe along the urethra, it passed at first into the bladder, but by a little manipulation it entered a small orifice leading to the cyst, and the point was felt in the cavity of the cyst through the anterior

vaginal wall. The tumour did not form again until the next time for emptying the bladder, when a portion of urine always passed into the cavity, which seemed like a diverticulum in the course of the urethra. The cavity of the cyst was evidently kept more or less constantly distended by the flow of urine into it; and it was habitually secreting pus, as proved by its admixture with the contents whenever squeezed out. I recommended that the patient should wear day and night one of Dr. Barnes's fiddle-shaped dilators—one-half being in the vagina, and the other half out—pressure in this way being exercised along the whole course of the urethra. This, I found, entirely prevented the filling of the