AN ADDRESS

ON THE

ANTISEPTIC SYSTEM OF TREATMENT IN SURGERY.*

Delivered before the Medico-Chirurgical Society of Glasgow.

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I HAVE now to show you a preparation illustrating the effects of the application of a ligature upon an artery on the antiseptic system. The theory of such a procedure is simple. A foreign body introduced among the tissues does not exert any disturbing influence upon them, unless it be either mechanically or chemically irritating. Thus, it is well known that a needle or a spiculum of glass may lie for an indefinite period embedded in the living textures without inducing suppuration; and any irritation which may result is due simply to the rigidity and form of the foreign solid. Now, a bit of silk or linen thread being composed of materials of soft consistence and as unstimulating chemically as glass or steel, its presence among the tissues cannot of itself occasion any disturbance. But, unlike the glass or metal, the thread is porous, and contains in its interstices putrefactive germs, which, developing in the serum that bathes the ligature, give rise to the acrid products of decomposition, and these, in their turn, stimulate the surrounding tissues to granulation and suppuration. If, however, the thread were steeped in some liquid calculated to destroy the life of the germs in its interstices, and the wound by which it was introduced were dressed antiseptically, the ends of the ligature being cut short, it might be left with confidence that its presence would not interfere with primary union, or occasion any disorder in the surrounding parts. [The traction exercised on the external coat by the noose of the ligature, is no doubt a temporary cause of mechanical irritation, but this does not appear to have any considerable influence.] Before applying these principles upon the human subject, I thought it right to test them on one of the lower animals.

Ligature of the Carotid Artery in the Horse, on the Antiseptic System.—On the 12th of December last, I tied the left carotid of a horse about the middle of the neck, using fine but strong "purse-silk, unwaxed, but steeped for some time in a saturated watery solution of carbolic acid. [The product of the action of carbolic acid upon blood serves the purpose of wax in preventing the first half of the knot from slipping during the tying of the second half.] The ligature having been tightly tied, so as to rupture the internal and middle coats, its ends were cut short, and the wound was freely treated with carbolic acid dissolved in forty parts of water. Seven stitches of the coarse soft wire used by veterinary surgeons for the purpose were introduced into the long wound, the most dependent part being left free for the escape of discharge. The hair around the wound was well rubbed with a solution of carbolic acid in four parts of olive oil, and cloths saturated with the same antiseptic oil were applied overlapping the surrounding skin freely, and retained in position by means which I need not describe; and similar oil was poured daily upon the cloths for the first six days. Ten days after the operation, I removed the dressings, and found the wound perfectly united throughout, except at the part purposely left open, which was covered with a sort of cheesy material, and as each stitch was removed, there was absence of even serous exudation. The wound was now left exposed, and in three days more the lower part had healed by scabbing, no suppuration having occurred from first to last. At the same time, there was none of the swelling and induration that usually attend the application of a ligature to a vessel in the horse's neck, and the animal showed no signs of uneasiness when the part was freely handled.

Five weeks and four days after the tying of the artery, the creature, though it had improved greatly in condition under its superior diet in the veterinary establishment, died, as the groom believed, of exhaustion from struggling ineffectually to rise from the recumbent posture. I had thus an opportunity of inspecting the parts concerned in the operation, some of which are now before you. In the first place, here is a portion of the skin containing the scar; and you will observe that it is a perfectly sound linear cicatrix, barely traceable among the hair. Here is the artery, slit up to show the condition of the interior. At the cardiac side of the place where the ligature was applied there was, as you see, an adherent coagulum, an inch and a quarter in length. But at the distal side there was no adherent clot, doubtless in consequence of the circulation through a large branch, about as big as the human vertebral, which came off,

you will observe, as close to the situation of the ligature as was possible. The *cul-de-sac* formed by the distal end, though it showed indications of the puckering of the divided internal and middle coats, was completely cicatrised, the smooth lining membrane of the artery being continuous over the irregular surface. Why it was that the immediate vicinity of so large a branch did not lead to secondary hæmorrhage, was clear from the state of things beside the ligature, which lay embedded in a firm fibrous structure, with not only no pus, but no granulations, no softening of tissue around it. The portion of the external coat included in the noose, though doubtless killed by the violence with which it was pinched, had not been thrown off as a slough, but, being unstimulating, because undecomposing, it had been absorbed and reproduced by the living parts near it; while the thread had been bridged over externally by dense fibrous tissue, so that the vessel showed but little appearance of constriction where it had been tied, and it appears to be as strong at this part as at any other. You may form some estimate of its strength from the manner in which it resists the traction to which I now subject it. Here is the ligature with its short cut ends, apparently unchanged, except that it was divided in my search for it in its fibrous bed.

This case confirms the hope I ventured to express at the meeting of the British Medical Association in Dublin last autumn (see the *BRITISH MEDICAL JOURNAL*, September 21st, 1867), that the antiseptic system would free the deligation of a large artery in its continuity of the two essential elements of danger to which it is now liable, viz., an unhealthy condition of the wound, and secondary hæmorrhage. Thus encouraged, I felt justified in carrying a similar practice into human surgery.

Case of Ligature of the External Iliac Artery on the Antiseptic System.—On the 29th of January of this year, I was requested by Dr. Fergus to see a lady fifty-one years of age, who was suffering from an inguinal aneurism which had existed for four years, but had of late been markedly on the increase, causing agonising pain, which had confined her to bed for the last four weeks, and had considerably reduced her strength. The aneurism was of the size of a large orange, affecting the uppermost part of the left femoral artery, and extending a little above Poupart's ligament. Any delay appearing undesirable, I tied the external iliac on the following day, in presence of Dr. Fergus, and assisted by Messrs. Hector Cameron, Appleton, and James Coats. There was nothing peculiar in the operation, except that the incision was made a little further outward than usual, in order to avoid the upper part of the aneurism. The only bleeding vessel that required attention was twisted. The ligature employed had been previously steeped for two hours in strong fluid carbolic acid, prepared by adding a small proportion of water to the crystals. The tightly twisted thread requires a considerable period of immersion to ensure thorough soaking with the liquid; and the acid does not impair the tenacity of the fibre. At the time of the operation, the superfluous acid was removed by transferring the silk to a solution of carbolic acid in thirty parts of water; and the same lotion was used for the sponges, and also for washing the aneurism-needle before it was passed round the vessel. The artery having been tied, and the ends of the ligature cut short, the wound was freely treated with the watery solution, some of which was poured in, to make sure that it penetrated to every part. The edges of the skin were then brought together with silver sutures, except in the middle, where I introduced a pledget of lint steeped in a solution of the acid in five parts of olive-oil; passing it deeply, but leaving one end projecting externally, to serve as a drain for blood and serum. I then applied an external antiseptic dressing, the details of which I need not now describe. The pledget of lint was cautiously withdrawn on the following day, under cover of a pretty large piece of lint imbued with the antiseptic oil; and the external dressing was reapplied, and afterwards changed at intervals proportioned to the diminution of the serous discharge, which, at the end of a fortnight, was estimated at about three minims in three days. At this time, some portions of lint, which had been left till then undisturbed, were removed, when the wound was found quite free from pus, being perfectly cicatrised where the sutures were introduced; while the central part, where the pledget was placed after the operation, presented the appearance of a superficial sore, but not a granulating one; for the deep surface of the dressing, being devoid of stimulating properties, had failed to induce granulation in the tissues on which it lay. Meanwhile the patient had been relieved from the pain which she previously suffered, without experiencing febrile disturbance or any material inconvenience from the operation, except uneasiness in the wound the first two days, during retching occasioned by the chloroform. The tongue had been natural throughout; the pulse had only on one day been as high as 90, 72 to 84 being the usual rates; and her appetite, which had been absent during the four weeks of agony that preceded the operation, returned two days after it, as soon as the derangement of the stomach from chloroform subsided. On the fourteenth day, as I was arranging her pillows, she sat upright without inconvenience.

Four weeks after the operation, the wound being completely cicatrised, she was allowed to move about in her room; and, just six weeks from the date of the ligature of the artery, she descended three long flights of stairs, walked for some time in the streets, and reascended the steps to her lodgings; and, though fatigued by the effort, she felt next day all the better for it. On March 31st, she called to see me, much improved in strength, though with still some tendency to swelling of the legs, especially the left, when in the erect posture. The aneurismal swelling felt merely like a slight glandular thickening. [On July 25th, 1868, I again visited her. She had derived much benefit from a stay at the seaside, and the tendency to oedema of the extremities was greatly diminished. There was still absence of pulsation in the external iliac artery, and the cicatrix remained quite sound twenty-five weeks after the operation; so that, whatever may have become of the ligature, there need be no apprehension of its ever making its appearance externally.]

The success of these cases of ligature depends, as we have seen, upon the circumstance that not only a neutral foreign body, but a portion of dead tissue, if simply protected from putrefaction, is entirely devoid of irritating properties. A good example of this fact is presented by a case at present under my care.

Case of Acute Necrosis treated on the Antiseptic System.—The patient is a boy, eight years of age, who was admitted into the Infirmary on Jan. 25th, 1868, having, five days previously, received a violent blow upon the left leg with a heavy pair of tongs, resulting in intense inflammation in the limb, which was red and swollen from the knee to the ankle. Fluctuation being distinctly perceptible over the upper part of the tibia, the matter was evacuated antiseptically. A piece of lint dipped in an oily solution of carbolic acid having been laid upon the part where the incision was to be made, its lower edge was raised to allow a knife smeared with the same solution to be plunged into the cavity of the abscess, when the curtain was at once dropped so that the pus might flow out beneath it. When all the matter had been pressed out, an external antiseptic dressing was applied, and this was afterwards changed daily. Four other abscesses afterwards made their appearance at intervals down the limb. These were treated in the same way; and in every case when a probe, carefully guarded by being passed among folds of lint steeped in the antiseptic oil, was introduced into the incision, it came into contact with bare bone. This was of itself sufficient evidence that portions of the tibia, of greater or less thickness, were dead; for, had the periosteum been raised by suppuration from living bone, the osseous surface would have become covered with granulations during the process. But evidence which must satisfy the most incredulous is afforded by the fact that, between two and three weeks after the first abscess was opened, a probe introduced into the orifice still passed down to bare bone. Under such circumstances, what, it may be asked, could be the advantage of continuing the antiseptic dressing? If dead bone was present, whether in larger or smaller amount, must it not become detached from the living osseous tissue by a gradual process of exfoliation, which an antiseptic applied to the skin could neither promote nor hinder? Such may be a natural inquiry. But having seen a large mass of dead bone absorbed before my eyes by the granulations that enveloped it, in a case of compound fracture treated antiseptically (see *Lancet*, March 23rd, 1867); and having also had evidence from *post mortem* examination in a case of hip-joint disease where extensive necrosis existed in connection with caries, that bone killed by inflammation might, under antiseptic management, fail to induce suppuration; putting those facts together, I thought it not unlikely that, in the case we are considering, the dead portions of the tibia would be absorbed by the living tissues around them, if we perseveringly maintained an effectual external antiseptic guard. Such, then, was the practice we pursued, and the result was such as I had anticipated. The various incisions successively healed, till by the 6th of this month (April), eleven weeks after the receipt of the injury which caused the attack, the abscess last opened was soundly closed and cicatrised, not a particle of dead bone having come away from any of the openings. At the same time, the swelling of the limb, instead of increasing, as is the case under ordinary treatment, from formation of new bone in the periosteum under the stimulating influence of exfoliations soaked with putrid liquids, had disappeared almost entirely from the upper part of the leg, which was that primarily affected, and was rapidly diminishing elsewhere. [On the 18th of May, the boy left the hospital with the full use of the limb. I had intended giving him a somewhat longer rest in bed as a measure of precaution. But I found that for a considerable time it had been impossible to keep him from getting up and running about the ward; and he was none the worse for his activity.] This certainly was very different from the tedious course of such cases under ordinary treatment.

With regard to the manner in which the dead bone has been disposed of, some who have not witnessed similar occurrences may doubt the possibility of its absorption, and believe that the necrosed pieces are still

lying unchanged in the interior of that leg. But even those who take such a view must admit that we have here a most striking illustration of the important truth, that dead tissue, if protected from putrefaction, is of itself incapable of exerting any disturbing influence upon surrounding parts.

(To be concluded.)

THE PATHOLOGY AND TREATMENT OF SUN-STROKE.

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Sun-Stroke or Heat-Apoplexy, more correctly Heat-Apnæa.—Causes.—Symptoms.—Morbidity Anatomy.—Pathology.—The over-heated Blood relaxes the Minute Pulmonary Arteries, and so floods the Capillaries.—The State of the Lungs in Cholera contrasted with that in Heat-Apnæa.—Treatment.—The main object is to cool the over-heated Blood, so as to restore the Contractile Power of the Minute Pulmonary Arteries, to lessen the Capillary Engorgement of the Lungs, and thus remove the State of Apnæa.

THE formidable disease known by the name of *sun-stroke* or *heat-apoplexy* might be more correctly designated *heat-apnæa*, as I shall presently endeavour to prove. Although this affection frequently occurs from direct exposure to the sun's rays, it is also of common occurrence without such exposure. The one essential and constant condition is a very high temperature of the air. The most powerful concurring causes are, muscular exertion and excessive fatigue; hot clothing, and especially such as tends to impede the respiratory movements; an excessive use of alcoholic liquors; and the close and impure air of hot and overcrowded rooms. The disease may be fatal in a few minutes, or the symptoms may last from one to forty-eight hours.

The rapidly fatal cases are spoken of as belonging to the *cardiac* variety. The patient falls unconscious, gasps, and dies. When the disease runs a less rapid course, it is said to be of the *cerebro-spinal* variety. There are great heat, dryness, and redness of the skin, giddiness, nausea, congestion of the eyes, and frequent desire to micturate; sometimes delirium, then drowsiness, passing into coma. The pupils are contracted; the breathing is hurried and laborious; the heart's action is tumultuous; the pulse rapid, at first distinct, but soon becoming feeble and irregular. Convulsions are of common occurrence, either early in the attack, or immediately before death. After death, however rapid may have been the course of the disease, the one constant condition is extreme, "unexampled" congestion of the lungs, with distension of the right side of the heart.

Dr. Maclean, to whose article on Sun-Stroke (*Reynolds's System of Medicine*) I would refer for a clear and succinct account of the facts of the disease, states that all modern pathologists are agreed that the superheating of the blood, which precedes and accompanies sun-stroke, has a depressing, and not a stimulating, effect on the nervous centres. In what way, then, does the over-heated blood exert this depressing effect on the nervous centres? I will endeavour to give what I believe to be the true physiological explanation of the phenomena.

The hot blood relaxes the muscular walls of the minute pulmonary arteries. The pulmonary capillaries are consequently flooded with blood. This overfulness of the capillaries interferes with the aëration of the blood. In fact, the overorged vessels must encroach upon the pulmonary vesicles, and so diminish the air-space within the lungs; while the air itself is highly rarefied. Hence a state of more or less complete apnæa. Un-aërated blood is sent to the muscular tissue of the heart, and to the brain: hence the cardiac and the cerebral symptoms. A similarly engorged state of the cutaneous capillaries, consequent upon extreme relaxation of the minute arteries, is the probable cause of the dryness of the skin. An excessively engorged state of the capillaries is as unfavourable for cutaneous secretion as it is for pulmonary respiration. The dry and inactive state of the skin and the want of surface-evaporation tend to elevate still more the temperature of the blood; and the suppressed cutaneous secretion, being diverted to the kidneys, probably alters the quality of the urine, renders it irritating to the bladder, and explains the frequent micturition.

This explanation of the phenomena is confirmed by the results of treatment. There is now a very general concurrence of opinion that the application of cold to the skin is the most successful remedy. The object to be kept in view is not merely, as it is generally stated, to cool the skin, or to excite the respiratory movements by the stimulus of the