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ON DISEASED CONDITIONS OF THE
 KNEE-JOINT.

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SECTION III.—'OPERATIVE INTERFERENCE.
 (Continued.)

*The Diseased Conditions requiring Amputation of
 the Thigh.*

THESE conditions I have designedly retained for consideration until the last, because amputation is the final procedure to which the surgeon can have recourse. I have already, as a matter of necessity, referred to many conditions of disease in which the operation of excision of the joint is not admissible, and where it becomes necessary to remove the limb by amputation through the thigh, in order to save the patient's life. Now, it becomes a question of serious import, whether the surgeon is justified in resorting to amputation of the limb in disease of the knee-joint for any other reason but to save life. Amputation of the thigh is a very serious proceeding, fraught with great danger to the patient, and resulting, under the most favourable circumstances of recovery, in the loss of "a perfect foot, a nearly perfect leg, a considerable portion of a nearly healthy thigh." (*Lectures on Progress of Anatomy and Surgery during the Present Century*, by Professor Ferguson. Lecture v.) The surgeon may well pause ere he performs so serious an operation upon his patient; and as long as any chance remains of saving the limb, the patient's life not being risked by the delay, the operation should be put off.

Still it must fall to the lot of every practical surgeon sometimes, however much he may endeavour to avoid it, to be obliged to amputate the limb for disease of the knee-joint; and I now propose to consider those cases which absolutely require this interference. But, before doing so, I shall refer, as in the case of excision of the knee, to the operation itself.

For reasons which I shall mention afterwards, the operation should always, if possible, be confined to the lower third of the thigh. It is seldom that the femur is so far implicated as to require section above this point; and, if the plan of exploration to which I have referred be carried out, the amputation may easily be completed, the soft parts being divided and dissected up from the bone with the same bistoury with which the knee-joint was laid open. This may seem a trivial point; but I have always been taught that simplicity is one of the great rules of surgery, and I never like to change an instrument during an operation, if it can possibly be avoided. It must be remembered that, in amputating the thigh in the lower third, there is a very great tendency for the femur to project forward through the wound, on account of the dragging of the hamstring muscles

on the posterior flap. This defect might be remedied by making Teale's rectangular flap; but I do not think that his plan is applicable here, as it necessitates the division of the bone too high up. It is proved by calculation that, if the transverse incision be made just above the patella, it would be necessary to divide the bone eleven inches above that point, to obtain the right proportion in the flaps. The plan adopted by Mr. Spence of Edinburgh, with a slight modification, is a good form of amputation; provided, of course, that the skin and surrounding soft tissues are healthy. A large anterior flap is made, the base being the original incision into the knee-joint, including as much muscle as possible. A very short posterior flap is then cut, the integument being dissected from the muscles, to free it from the contractions. The bone may then be divided very low down; and, the flaps being brought together, an excellent pad will be formed for the end of the bone, and the cicatrix of the wound will be sufficiently posterior to avoid pressure. Mr. Carden of Worcester has published a paper in the *BRITISH MEDICAL JOURNAL* (April 16th, 1864), in which he describes an operation very similar to this, and gives numerous woodcuts, showing admirable results. If the disease of the bone or soft parts necessitates an amputation higher up, Teale's, or the ordinary anterior and posterior flap operations, will be serviceable. Pus burrowing high up amongst the muscles is no indication for a high operation, as the removal of the cause of the abscess will very soon cure it. I have already referred to the necessity for extreme "conservatism" in amputation of the thigh; and I have done so because it has been proved that, in proportion to the advance of the section up the thigh, is the rate of mortality following the operation. The following is a table extracted from Macleod's *Notes on the Crimean War*, showing the rate of mortality following amputation of the thigh in various parts.

	Per cent.
At the upper third.....	87.0
„ middle third	60.0
„ lower third	56.6
„ knee-joint	55.5

Thus it will be seen that saving a few inches of femur materially lessens the chances against the patient.

It is possible that, in some exceptional cases, where disease is not much advanced, but the constitutional condition of the patient demands amputation, the operation may be performed through the knee-joint, the diseased articular surfaces being sawn off, and the posterior flap obtained from the calf of the leg. This amputation has been performed for disease of the knee-joint with the best results, and, when it can be practised, must conduce to the safety of the patient. I have had the care of cases of amputation through the knee for disease below the joint, and can testify to the admirable stump which is thus formed.

I have given up the use of wire sutures in such cases, as there is no benefit derived from them, and their removal is a source of great pain to the patient. Moreover, the ends are apt to catch in everything with which they come into contact, and so give rise to a great deal of needless distress and irritation. (See Humphry's Address in Surgery, *BRITISH MEDICAL JOURNAL*, August 13th, 1864, p. 179.)

Three silk sutures are all that are generally required, and they may be removed at the end of the third day.

The after-treatment should be of the simplest. In the majority of cases, there is not the slightest necessity for the application of any dressing whatever—at any rate, for some days. The less the stump is meddled with, the less pain inflicted on the patient, and the better chance of rapid recovery. One application only I find very useful, especially when the flaps are rather large and heavy; and that is a back splint of gutta percha, moulded to the posterior surface of the stump, and retained in its place by a turn or two of bandage. In the ordinary run of cases, the wound is healed in about a month or six weeks; but, at the end of that period, it frequently happens that sinuses still remain open, which require a long period of time for perfect cure. Even when the stump is perfectly healed, and the case pronounced “cured”, it is still a considerable period before the patient can bear the application of any apparatus on which to walk. Taking an ordinary case of excision of the knee and an ordinary case of amputation of the thigh, I believe that the one will walk on his foot pretty nearly as soon as the other on his wooden leg.

The after-results of amputation of the thigh are not always as satisfactory as we could wish, and present as many drawbacks to the operation as exist to excision of the knee. The most frequent bad result is conical stump, even after an apparently good pad of soft tissue has been provided. Mr. Hancock has referred, in the *Lancet* of July 23rd, 1859, to a condition of “painful cicatrix and irritable stump”. In the former, the skin is in close contact with the periosteum; and, instead of dissecting out the cicatrix, which is the usual mode of treatment, Mr. Hancock is in the habit of performing “subcutaneous separation of it from the periosteum”, and preventing adhesion again taking place by constantly moving the skin backwards and forwards. In irritable stump, Mr. Hancock pursues the same method, thinking that the pain arises more from the adhesion of the skin to the bone and periosteum, than from the implication of the nerve or its bulb. Barwell quotes a case of Mr. Hancock’s where amputation of the thigh was twice performed for this condition, and lastly, that of the hip, after which the patient died. Necrosis of the end of the femur is another troublesome condition, which much delays the cure. If the periosteum be stripped back from the bone during the operation, a ring of bone will, in all probability, exfoliate. I saw, not long since, a stump removed just below the *trochanter major*, in which the remaining shaft of the femur had died, and was inclosed in new bone. Thus, like the operation for excision, the recovery from amputation of the thigh is not always rapid or free from after-complications. It has, however, escaped the severe criticism to which its sister operation has been subjected, and is often allowed to bear off the palm for rapidity of convalescence and decreased danger to the patient.

The statistics as to the mortality following amputation of the thigh are, like those of excision of the knee, not very reliable. Certainly, in this respect, our country hospitals are in advance of those situated in large cities—a fact which, of course, we are not surprised to learn. Thus, at the Exeter Hospital,

out of 119 cases of amputation of the thigh, only ten died; and at the Plymouth Hospital, out of about forty cases, only three have died.

Against these figures, I must place the figures of excision of the knee-joint in these two institutions. In the Exeter Hospital, eighteen cases have been operated on, and sixteen have recovered with good limbs. In the Plymouth Hospital, eight cases of excision have been performed; five have recovered with good limbs, and one is still under treatment and going on very well.

I place these results side by side in order to show that the same causes which influence the success of amputation in all probability will equally affect excision.

But to return to the statistics of the mortality after amputation of the thigh.

From various sources, Price has collected a number of cases, which I tabulate.

	Cases.	Deaths.
Jäger.....	23.....	10
Benedikt.....	36.....	11
Chelius.....	10.....	1
Roux.....	16.....	9
Dupuytren.....	11.....	9
St. Thomas’s Hospital, from 1835 to 1840.....	13.....	4
University College Hospital.....	46.....	9
	145	53

This list shows a very high rate of mortality; higher, no doubt, than the average. Teale shows the rate of death to be about one in four or five; whilst Bryant places the mortality from amputation for disease of joints at one in seven (*Medico-Chirurgical Transactions*, 1860)—although I think this a very low average.

Mr. Sansom, in a paper read before the Medical Society of King’s College, gives fifty-four amputations of the thigh for diseased knee; of which nine died, or one in six. In the year 1855, he gives sixty-nine cases; of which sixteen died, or about one in four.

The average of deaths following amputation of the thigh after injury is of course very much higher.

During the Crimean war, the percentage of deaths after amputation of the thigh in the lower third was 56.6.

The usual causes of deaths are pyæmia, shock, exhaustion, and secondary hæmorrhage. Of the fifty-four cases quoted above, five died of pyæmia, two of shock, one from exhaustion, and one from tetanus. Pyæmia is, as this table indicates, the most fertile source of death after amputation of the thigh.

In Price’s table of the causes of death, which occurred in the 238 cases of excision he collected, he gives ten deaths only from pyæmia. Thus, in the amputations of the thigh, the deaths were about one in eleven, whilst in the excisions they were only one in twenty-four.

This fact is well worthy of notice, because the occurrence of pyæmia has been held up as one of the chief objections to excision of the knee; and the fact that in that operation the cancellous structure of the bones is so freely exposed; was thought to be the chief cause. Now it appears, that pyæmia is more than twice as frequent after amputation

as after excision. Dr. Wilks, in his *Pathological Anatomy*, p. 464, makes the following pertinent remarks on this subject.

"There are particular sorts of wounds and injuries which favour the absorption of matter into the blood, and, above all, those where the bone is exposed; thus, after amputation and injuries to any part of the skeleton they are most common. Mr. Bryant informs me that half of the deaths from amputation arise from pyæmia, and my own experience confirms this..... It remains a question whether the putrid elements are conveyed through the medulla rather than by the solid or cancellous structure of bone; and in relation to this matter, whether pyæmia is less frequent after excision of a joint than after amputation."

I believe the figures quoted above to be an answer to this query; and that absorption takes place more readily from the medullary canal than from the cancellous structure of the bones.

Death from shock, although not so frequent as from pyæmia, stands next on the list. It arises from the severance of large vessels and nerves, and from the great loss of blood which frequently attends the operation. The removal of so large a portion of the body, with the blood contained in the limb, is in itself a great shock to the patient. Death usually takes place in from twenty-four to thirty-six hours after the operation.

Exhaustion is but a sort of prolonged shock, the patient never recovering from the immediate effects of the operation, but lingering on for days, or even weeks, and at last sinking, with all the powers of Nature thoroughly worn out.

Secondary hæmorrhage may occur at various periods, either soon after the operation from the open mouth of some vessel undetected at the time of operation, or from imperfect closure of the orifice at the time of the separation of the ligature, or from sloughing of the wound laying open vessels.

These are the principal sources of death after amputation of the thigh. I have shown that pyæmia is less prevalent after excision of the knee; and I am quite certain that the same may be said of shock. As a matter of personal experience, I am sure that the shock after excision of the knee is very much less than after amputation of the thigh. It stands to reason that it should be so. In excision, nearly all the causes of shock are avoided. No large vessels or nerves are divided, little or no blood is lost, and the limb still remains attached to the body. I do not deny that in some cases, especially if the limb be ill adjusted, the patient suffers more severe pain after excision than after amputation; but pain and shock are two very different matters—in fact, the entire absence of the former not unfrequently indicates the presence of the latter.

I have already shown that secondary hæmorrhage after excision may be avoided; at any rate, it is of far less importance than when occurring from a large vessel in a stump after amputation.

[To be continued.]

POLLUTION OF RIVERS. The Royal Commissioners appointed to inquire into the pollution of rivers are still pursuing the inquiry at Pontefract, in Yorkshire, relative to the Aire and Calder rivers. It is hoped that the commissioners' report will be laid before Parliament shortly after its meeting.

Addresses and Papers

READ AT

THE THIRTY-FOURTH ANNUAL MEETING OF THE BRITISH MEDICAL ASSOCIATION.

[Held in CHESTER, AUGUST 7th, 8th, 9th, and 10th, 1866.]

ON THE ORIGIN OF PYÆMIA.

By ALFRED BAKER, Esq., Birmingham.

THE term Pyæmia implies pus in the blood; and it has been applied to certain morbid conditions of the system in which the circulating fluid has its constituents altered, and its distribution disturbed, whether these results follow its admixture with pus or with any other morbid agent.

Notwithstanding Piorry's statement that the blood itself is subject to inflammation, in which disorder pus-corpuscles were supposed to be intermixed in large proportion with the true blood-globules; Gulliver's imaginary discovery of pus-globules in the blood of persons suffering under typhoid diseases; and the subsequent declaration by Mayo, that pus-globules existed in the blood of every one; it is now believed that pus cannot be recognised in the blood by any known distinctive characters, and that the cells observed by these gentlemen, and mistaken for pus-cells, were really white blood-globules.

During the course of wasting diseases, especially if the lymphatic glands be affected, these white globules are often met with in considerable excess; and they are not infrequently too numerous in the subjects of pyæmia, although there is no necessary connection between their presence and the occurrence of that malady.

Dr. Hughes Bennett drew attention to this condition of blood in a paper on Leucocythemia, and confessed that at first he mistook the white blood-cells for pus-corpuscles. Both he and Virchow agree as to the two classes of cells being precisely similar, and the latter author declares it to be impossible to distinguish them excepting by their mode of origin; he says: "If this prove to be external to the blood, you may safely conclude that it is pus; but if this is not the case, you have to do with blood-cells."

Piorry's supposition of a purulent condition of the mass of blood being thus disproved, it was suggested by Arnott, in explanation of the origin of Pyæmia, that it sprang from suppurative phlebitis; that the pus formed in the inflamed veins was carried into the circulation; and that the pus-globules, being larger than the blood-globules, became arrested in the minute capillaries, and gave rise to secondary abscesses.

To some extent John Hunter's views as to the identity of the anatomical structure, and inferentially of the pathological changes in veins, with those which are seen in serous membranes, gave colour to this theory. Regarding the veins as peculiarly liable to adhesive and to suppurative inflammation, he considered that discoloration of the lining membrane, a deposit of lymph on the surface, and the presence of a clot in the vein, which, whilst dark coloured externally, was frequently creamy and diffuent within, were unquestionable proofs of phlebitis. It is now known that these premises are erroneous; that anatomically the lining of a vein bears no resemblance to serous membrane; that its discoloration is due to