The proper period for the performance of amputation in cases of traumatic injuries / by B.A. Watson.

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IN CASES OF

Traumatic Injuries,

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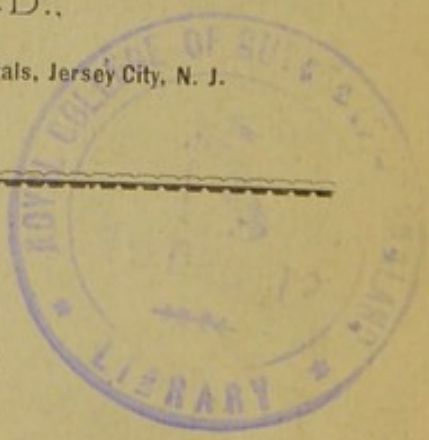

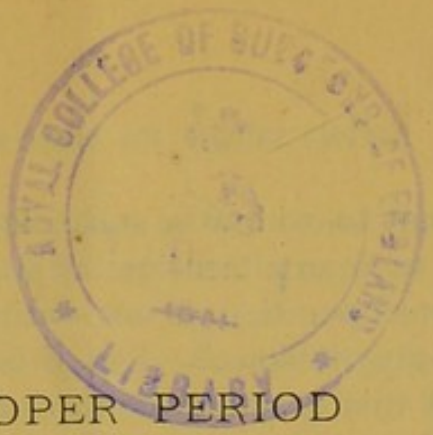

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When a traumatic lesion has rendered the performance of amputation absolutely necessary, it then becomes important to determine the most favorable time for the accomplishment of this object. This question is not new, has frequently been the subject of protracted discussions, and, it was not until the present century that any unanimity of opinion could be claimed to exist on this point among surgeons. Military surgeons were the first to advocate the immediate performance of this operation, as is shown by the writings of Wiseman, Ranby, and LeDran. Ranby says,* "If a wound be of such a desperate nature as to require amputation, (which is always the case when it happens in any principal joint,) it would certainly be of consequence could the operation be performed on the spot, even in the field of battle; lest, by deferring it, an inflammation may come on, which one may very reasonably expect should obstruct a work that ought rarely to be entered upon during the continuance of so calamitous a circumstance. The neglecting this critical juncture of taking off a limb, frequently reduces

* Cheluis' System of Surgery by South, Vol. I. p. 380.

the patient to so low a state, and subjects the blood and juices to such an alteration, as must unavoidably render the subsequent operation, if not entirely unsuccessful, at least exceedingly dubious." The French Academy of Surgery proposed this question as the subject for a prize essay in 1755, and again in 1756. This discussion was participated in by Faure, Leconte and Boucher. The Academy awarded the prize to Faure, and have, therefore, been accused of deciding in favor of delaying the operation whenever practicable, although from the first it were absolutely necessary. This accusation is however shown to be unjust by the exceptions noted in Faure's paper.

Faure thought that an amputation performed immediately or very soon after the receipt of an injury would be dangerous, because nature seems to demand that an operation of this importance, which produces so much disturbance of the natural function of the animal economy should never be done during the period of the most violent agitation, and while the patient is in the highest state of bodily excitement. He admits only of exceptions in the following cases :

1. When the limb has been torn from the body. 2. When a comminuted fracture involves a large articulation, whether caused by gunshot wound or otherwise. 3. When an extremity is almost destroyed, the bone being extensively comminuted, with considerable loss of the soft parts. 4. When the bones are extensively comminuted and the adjacent tissues are injured and contused, with destruction of the tendinous and aponeurotic structures. 5. If a fracture involves an articulation even in the slightest degree with a considerable destruction of the ligaments of the joint, hæmorrhage from an arterial trunk of an extremity which endangers the safety of the patient and cannot be controlled except by amputation.

Leconte, a physician of Acueil, advocated the same ideas in his memoir which received an honorable mention, and was published in the collection of prize essays by the Academy of Surgery.

Boucher argued in favor of immediate amputation, and justly claimed that delaying an amputation made necessary

by a traumatic injury, exposed the patient unnecessarily to the dangers arising from inflammation, gangrene, diffuse suppuration, purulent infection and tetanus ; thus destroying many lives which could have been saved by a prompt operation. This opinion, expressed by Boucher, has long since prevailed among French surgeons, who have unanimously pronounced in favor of immediate amputations.

Dubois, cited by M. Velpeau, asserts that the French surgeons during the American revolution in 1780, lost nearly all their patients on whom they performed any amputation, although the American surgeons who performed the same operations on the field, saved nearly all their cases.

There is conclusive proof that the English Military surgeons, even while the French Academy of Surgeons were debating the question of immediate amputation, continued to advocate and practice it in their armies. Dr. Hennen says : * "It is but justice to British surgeons, both naval and military, to declare, that immediate amputation is neither a new doctrine, nor a recent practice among them. How long it may have been in use in the former service I cannot undertake to say ; but every naval surgeon with whom I have conversed informs me, that he always employed the knife where its use was indispensable, *at once*,— which implies a much earlier opportunity than army surgeons can possibly enjoy. To advert to the experience of our service in the late wars ; surgeons who served in 1794 on the Continent, assure me, that the greatest benefit resulted from immediate amputation, which they had recourse to whenever they possibly could. I have the authority of my friend, Dr. Pitcairn, deputy inspector of hospitals, who served as surgeon on the Staff of the Egyptian expedition, to state, that whenever the surgeons could operate upon the field in that country they did so ; and, for himself, he only lamented that he could not remove more limbs in that situation, having never had any doubt upon the point, and being still more convinced in the justice of his opinion by the results of the deferred operation. On the first land-

* Principles of Military Surgery, Phila., 1830, p. 55.

ing of our troops in Portugal, the propriety of the practice was impressed upon the surgeons, as I have been informed by Mr. Gunning, then senior surgeon upon the staff, and subseqently surgeon-in-chief of the Peninsular army ; the practice was constantly followed, and the precept orally delivered from surgeon to surgeon during the whole period that I served in that country, and the able work of Mr. Guthrie forcibly elucidates its propriety ; while the utility of the same practice, as adopted by the French, is fully shown by M. Larrey. Finally, the results of the field amputations after the battle of Waterloo, confirm the published experience of both these writers, and it is to be hoped that the question is now set at rest forever."

These views were not shared by Mr. Hunter, who in writing on this subject remarks :* "Nothing can be more improper than this practice," and he proceeds to assign his reasons which have long since been shown to be fallacious. The opinion here expressed by this distinguished surgeon had very little influence on military surgeons, and they merely deigned to answer by asserting that civil surgeons were not in such a position as to enable them to form a correct opinion of the advantages of primary amputations.

Erichsen says :† "In military practice, secondary amputation is, in general, more fatal than primary. Thus, Faure saved only 30 out of 300 secondary amputations, whilst Larrey saved three-fourths of those in which he amputated primarily. In the Peninsular war, the mortality after secondary amputation of the upper extremity was twelve times, and after secondary amputation of the lower limb, three times, as great as after primary amputation of these parts. In the British army in the Crimea, from the 1st of April to the close of the war, the relative rates of mortality per cent. after primary and secondary amputations was as follows :—after *primary* amputations at the shoulder, 26 ; of the arm, 17 ; of the fore-arm, 3 ; of the thigh, 62 ; of the leg, 30 ; and of the foot, 17 ; after *secondary* amputations at the shoulder, 66 ; of the arm, 31 ; of the fore-arm, 28 ; of the thigh, 80 ; and

* On the Blood, Inflammation and Gunshot Wounds, Phila., 1841, p. 538.

† Science and Art of Surgery. Seventh Amer. Ed. Vol. I, p. 83.

of the leg, 76. Or, for the upper extremity, the whole rate of deaths after primary was 15, against 41 after secondary amputations; whilst, for the lower extremity, excluding the foot, it was 46 for the primary, against 78 per cent. for the secondary.

In the American army during the war of the Rebellion, the mortality after primary amputation of the thigh was 54.13 per cent.; and after secondary amputation, 74.76. In the French army in the Crimea, on the other hand, the mortality after primary amputation of the thigh and arm—amounting in the former limb to above 90 per cent.—was greater than that after the secondary operation. As has already been observed, not only does the *rate* of mortality differ in primary and secondary amputations, but also the *cause* of death. Primary amputations are most frequently fatal from shock, hæmorrhage, and exhaustion, although death from pyæmia and secondary diseases of a low type is by no means rare in these cases. Secondary amputations for injury most commonly carry off the patient by the supervention of septic diseases." Experience, observation and science have finally convinced surgeons, both military and civil, of the advantages of the primary amputation over the secondary; and the conclusion seems to be fully supported by statistics, but the value of these is greatly impaired by the following: 1. Irregularities in the classification. 2. Insufficient data to enable the compiler to determine the existence or character of complications. 3. Idiosyncrasy of compilers which produces interpretations of figures favorable to their own preconceived theories and opinions. The irregularities in the classification of amputations arising from the fact that one author divides this operation into four classes, which he designates as *immediate*, *primary*, *intermediate* and *secondary*; another separates it into three classes which he calls *primary*, *intermediate*, *mediate* or *consecutive*, and *secondary*; and the third still farther simplifies it and gives us in his nomenclature only the *primary* and *secondary*. The intention of all surgical writers on this subject has unquestionably been to designate by these terms pathological conditions which it was supposed might have important bear-

ings on the result of surgical operations. Have these authors succeeded in impressing on the minds of the majority of their readers these facts ?

The selection of these terms must be regarded as unfortunate, since the words themselves, as commonly employed, fail to convey to the ordinary professional mind the faintest idea of pathological conditions but do commonly suggest certain periods of time. Prof. Frank H. Hamilton says :* "The immediate period is the space of time comprised within the first few hours ; and it will be convenient to establish its limit at the expiration of six hours. It refers to that condition of the general system, and more especially of the nervous system, which has been termed 'shock.'" The same author says of this complication :† "*Shock* is that condition of the nervous system which immediately ensues upon severe injuries in certain persons, characterized by coldness of the surface, pallor, and a feeble pulse ; to these conditions are sometimes added tremors, a wild, anxious expression of the face, partial or complete paralysis of the bladder and sometimes of other organs, mental disquiet or apprehension, incoherent speech, etc.; which phenomena may continue a longer or shorter period, but usually, unless the shock is severe, they disappear in a few hours. When the accident is of a more grave character, no reaction occurs, and the patient dies immediately, or within a short time. In general it may be said, that if reaction does not occur within twenty-four, or at most forty-eight hours, the patient will die. In some cases the occurrence of the shock seems to be delayed, the depressing influence of the injury not being felt until some little time after. . . . . Surgeons who hold to the frequent occurrence of delayed shock, recognize in this an argument in favor of 'immediate' amputation in a great majority of cases ; and certainly, assuming the premises to be correct, the argument seems not unsound."

Says McLeod, "If this precious moment could be seized

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* Principles and Practice of Surgery, p. 340.

† Ibid., p. 341.

at all times, and that operation performed under chloroform, which assists so much in warding off the 'ebranlement' we fear, how much more successful would our results prove than under other circumstances they can ever be." . . . . Larrey, indeed, seemed to regard amputation as the proper remedy for this peculiar condition of the nervous system. 'I have lost,' said he, 'a great number of soldiers, because, although operated upon within the first twenty-four hours, yet the operations had been made too late.'" There is a possibility that shock may in some instances be delayed; but these occurrences are unquestionably rare, and the cause of such delay is generally revealed by an autopsy. My own observation and study of this condition is strictly in accordance with the views expressed by Prof. Hamilton when he says:* "For ourselves, we confess that we have never met with these examples, except when some visceral lesion, or the rupture of a large blood-vessel, has accompanied the accident. It is true that men often faint after a few minutes, or after removal, and when they have had time to contemplate their situation, who seemed undisturbed at first; and in other cases, a severe and prolonged irritation from a point of bone has steadily aggravated the signs of depression and of shock; but we think these cannot with propriety be termed examples of delayed shock." M. Sedillot, of Lyons, expresses the opinion that it is "the best rule to amputate on the second or third day." Prof. Hamilton says:† "I must differ from him so far as to say that in general the first or second days are to be preferred, that is, the period after the shock, but within the first forty-eight hours. My own opinion upon this subject is, that amputations ought to be made in some cases immediately, or as soon as possible after the receipt of the injury; as, for example, when a limb is nearly torn off and a dangerous hæmorrhage, which cannot be arrested, is occurring; or when spicula of bone, such as neither the forceps nor fingers can extricate, are causing intense suffering. In all cases of injuries to small limbs, such as the fingers and toes, im-

* Ibid., p. 341. † Ibid., p. 342.

mediate amputation is proper; and in a considerable number of cases of injuries to larger limbs, when it is clearly seen that the patient is not faint, or depressed, or suffering under great nervous commotion. But I cannot accept of the doctrine of Paré, Wiseman, Larrey, McLeod, and others, without liberal qualifications, and a careful specification of the cases to which their rules are to be made applicable."

In accordance with the views expressed by Hamilton and others, the immediate amputation differs in no essential particular from the primary, except so far as the operation may be influenced by shock and this condition may be entirely absent, or present in varying degrees, after the receipt of an injury during the first few hours, or even days, but its period of duration is of great uncertainty. Neither is this the only dangerous complication that must necessarily influence the action of the surgeon during the first few hours after the receipt of injury by his patient. Already attention has been called to certain forms of hæmorrhage which demand the prompt removal of the injured limb, as well as other lesions which ought either to expedite or delay operative procedure.

In consideration of these facts, it seems to me advantageous to drop the term "immediate" and employ the word primary when speaking of any operation which has been, or is to be performed prior to the development of the symptoms which indicate the existence of any form of septic infection. This term primary should be employed with *sole reference* to the pathological condition, and without the *slightest regard* to the lapse of time after the receipt of the injury. The necessity for adhering strictly to this rule is found in the fact, that septic diseases arise in some patients much sooner than in others, while the surroundings of the case will be found to influence greatly the development of this important complication. Favorable hygienic surroundings will unquestionably, in certain cases prevent these diseases, while in other instances it will only delay the evil day, and *vice versa*.

Another particularly important factor in cases of compound fractures and similar lesions, is the local treatment

employed after the receipt of the injury. It has already been demonstrated that by the use of the antiseptic treatment it is possible in many cases even in the presence of most unfavorable hygienic surroundings to prevent septic infection. This fact should not be forgotten by the surgeon nor neglected in his practice. It frequently happens that a surgeon is called immediately after the receipt of a severe injury complicated by open wounds ; and after having made a careful examination, finds himself unable to decide whether an amputation is *absolutely demanded* or not. Under these circumstances the surgeon should *adhere strictly* to the rules of antiseptic treatment, and having done this and succeeded in preventing septic infection, he may rest assured that the amputation of the limb can be performed as safely after the lapse of ten days as at the end of the first. This is certainly a very important feature of antiseptic treatment which is applicable to the practice of conservative surgery, and it enables the surgeon to watch the restorative powers of nature in many cases without jeopardizing the life of the patient. The same practice not only enables the careful, painstaking surgeon to avoid septic infection, but even in cases where this condition is found to prevail, it greatly lessens here the danger arising from the performance of the amputation. Unquestionably the chief danger in this operation is due to the fact, that the patient who is already suffering from septic infection is destined by the old methods of operative procedure to receive into his system another dose of the same poison, and in those cases where nature was barely able to eliminate the first installment, she would be completely overwhelmed by the second.

The various diseases arising from septic infection in open wounds unquestionably destroy more lives than all other wound complications. This fact gives a vital importance to septic infection which, it is thought, may justify us in designating all amputations performed during the existence of this condition as secondary amputations. It should not, however, be forgotten that in some cases septic infection may have existed in connection with an open wound, prior to the performance of an operation, but every trace of this

morbid condition having disappeared, the operation becomes essentially primary, and should be so designated. The advantages claimed for this nomenclature are as follows : 1. It is based on distinct pathological conditions, the effects of which are strikingly manifested in the termination of amputation. 2. These conditions are not so closely allied to certain fixed periods as thereby to associate the idea of success or failure with the time when the operation was performed, instead of attributing it to the condition of the patient, or the existence of complications. Neither this nomenclature nor any other, which has yet been suggested, enables a surgeon to describe the condition of a patient so thoroughly as is desirable, without employing other terms for the purpose of expressing the character of the complication, and the existing degree of lesion.

Visceral lesions, whether due to a traumatism or disease, the various forms of septic infection, or the existence of shock, slight, severe or reactionary, should be noted in connection with amputation, as well as any other complication which can possibly affect the result of the operation. It will be readily admitted that the result of an amputation, other things being the same, will depend on the complication, and no surgeon will deny that septic infection is a most serious condition. The old writers generally spoke of amputation as the opprobrium of surgery, but modern surgeons regard the performance of this operation under certain circumstances as a grand surgical achievement. Had the ancients restricted the use of the term to that amputation which is commonly designated *intermediate*, but which we prefer to call *secondary*, it would certainly be accepted as more appropriate in modern times ; not only on account of the great fatality attending the performance of this operation, but also from the fact that a mistake made by the surgeon at the outset frequently compels him to choose between two evils, viz : Those attending the performance of a secondary amputation, or those which arise while awaiting the formation of a line of demarcation. In cases of gangrene the formation of the line of demarcation has long been regarded by surgeons as indicating an approximation to the

time when the performance of an amputation is attended with the minimum of danger. It is possible, however, that the highest degree of safety may be found after the formation of the line of separation and the development of granulations, which cover the extreme border of the lining tissue.

The pathological changes involved in these processes are such as to thoroughly convince us that the increased safety in these conditions depends essentially on the formation of a barrier, which at first merely impedes, but finally arrests the absorption of septic material, and furthermore on the elimination by the natural emunctories of the poison which had already been absorbed. While it must be admitted that surgeons at all times prefer to operate on patients who are entirely free from septic infection, nevertheless there are circumstances under which the *amputation of a limb should be performed without awaiting a more favorable period.* The intelligent performance of this operation at such times requires that the surgeon should determine as accurately as possible, the degree of danger which may be justly expected to arise from the contemplated operative procedure. Many important points bearing on this subject have not yet been examined with sufficient care to enable us to understand their value in this connection. How far may we depend on the temperature in indicating the danger from septic absorption under such circumstances? Are there conditions under which the poison after its absorption may remain latent in the system? No attempt will be made to answer these queries; but it is rational to presume that in cases of traumatic gangrene the progress of the septic infection will in a measure depend on the rapidity with which the living tissues lose their vitality, and the extent of the disease. Rapidly spreading gangrene does not allow nature time to raise the barriers which she employs to impede the progress of this contamination, and the more extensive the gangrenous action, the greater are the number of absorbents which take up and disseminate the poison. It may therefore be claimed that the danger in cases of operative procedure from septic infection, will generally bear a certain relation to these fac-

tors ; but they do not constitute a basis which justifies a surgeon in recognizing the existence of latent septic infection, and consequently refusing to operate in the absence of the symptoms which indicate the existence of this danger.

My opinion on this subject is in harmony with that expressed by Thomas Bryant, F.R.C.S., who says :* "In a case of compound fracture, which is so bad as to suggest the necessity of primary amputation, but in which the surgeon has been desirous, if possible, of saving the limb, the first onset of an inflammatory action that assumes a gangrenous form should be met by amputation ; which in a case less severe, where the injured limb has a good prospect of being made an useful one, an attack of inflammatory gangrene need not necessarily lead to its loss."

Prof. Agnew says :† "In incipient trumatic mortification, —that which begins within what is called the primary period (from thirty-six to forty-eight hours),—the surgeon should operate at once, without waiting for any line of separation, provided the patient's general condition will allow."

A careful consideration of the advantages and dangers attendant on the performance of primary and secondary amputations in cases of traumatic injuries cannot fail to satisfy the most *rigid inquirer*, that the former operation *is infinitely to be preferred to the latter ;* and furthermore, that every operation as a general rule should be performed in these cases *as soon as possible after the receipt of the injury;* unless there exists a condition or complication which renders this procedure immediately dangerous to the life of the patient.

The existence of shock in a mild form dependent entirely on an injury to a foot or hand can never justify a surgeon in *postponing an unavoidable amputation ;* but should there be recognized, besides that already mentioned, a traumatism involving the visceral organs, the degree of the same not

* Practice of Surgery, 2d Amer. Ed. p. 44.

† Principles and Practice of Surgery, Vol. I., p. 134.

being immediately determinable, a brief delay under these circumstances would certainly be judicious during the early part of the immediate period. The surgeon ought generally to be able to give a negative answer to the query,—will the patient die before the amputation is completed? Although there are cases which form an exception to this rule. Hæmorrhage in some instances can only be controlled after an amputation has been performed; and in these cases it is necessary that the surgeon should satisfy himself that the performance of the operation gives the patient the *best possible chance for life* in order to justify it, and after *having reached this conclusion, longer delay is culpable.* Neither should the application of this law be limited to cases of hæmorrhage, but whenever a surgeon recognizes the fact *that the prompt performance of an amputation gives his patient the only, or decidedly the best chance for life, although this may be small, duty and humanity alike demand prompt action.* Let no surgeon under such circumstances stop to ask himself—what may be the effect of this operation on my professional reputation? but do not forget that these remarks are only intended to apply to those cases in which the amputation is *recognized as unavoidable.* The moment the Surgeon recognizes a doubt in regard to the necessity of the amputation, or the effect of the same on the chances of the patient, he should then endeavor to obtain additional information, and should he fail in this he may be justified in hesitating, postponing or refusing to act until such times as he is able to reach a satisfactory conclusion. It must be finally admitted that no specific rules can be given which will be applicable to all cases of traumatism in determining the time when an amputation should be invariably performed; although general rules may be useful, still the determination of the best time for the performance of the operation is merely a question for the professional attendant; and whether his decisions will be advantageous or otherwise to his patient must always depend on his knowledge of the various questions involved in the particular case under consideration, rather than any fixed rules.