THE PHYSICS OF A SURGICAL DRESSING,
WITH SPECIAL REFERENCE TO THE HARMFUL EFFECT OF
USING IMPERMEABLE MATERIAL OVER
SEPTIC WOUNDS.

BY

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A NUMBER of most interesting papers by Sir Almroth Wright have recently appeared in the BRITISH MEDICAL JOURNAL, in which he demonstrates by a most complete series of ingenious laboratory experiments a method of securing the drainage of septic wounds received in war. He further gives an account of the practical value of these methods as employed in the treatment of men wounded in France during the present war. In his last communication, Part III of his lecture on "Wound infections and their treatment,"¹ he gives his scheme for the practical treatment of wound infections "from the first-aid post back through the whole system of hospitals." In the field ambulance he applies a wet dressing of 5 per cent. solution of sodium chloride and 0.5 per cent. sodium citrate, and he states, "over the top of all ought to come a layer of *impervious protective tissue*" (the italics are mine). I wish to suggest that as a scheme for "drainage," the effectiveness of the dressing is entirely upset by the "impermeable protective." It should be noted, too, that in the same paragraph he definitely states that his object is "the procuring of drainage."

My attention was first called to the harmful use of impermeable material such as protective, oil-silk, rubber adhesive, etc., by a paper on the physics of a surgical dressing published about ten or fifteen years ago in the *Annales de l'Institut Pasteur*. Since reading it I have had many opportunities of observing clinically, in my hospital wards in Toronto, the deleterious effects of impermeable dressings.

The experiments, so far as I can recall them, were of the following character: An animal was prepared by shaving a portion of the skin surface and then an area was excoriated sufficiently to draw blood. This area was covered with powdered strychnine and a piece of oil-silk was secured over it, so that evaporation from the surface was prevented. The animal died of strychnine poisoning. Another similar experiment was done, save that the oil-silk was replaced by an absorbent dressing, allowing of evaporation from the surface and absorption of secretions into the dressing. These animals showed no symptoms of poisoning. Similar experiments were done with some virulent bacteria, with similar results: under impermeable oil-silk septic absorption occurred, and under a simple absorbent dressing no sepsis resulted. There were, too, a series of laboratory experiments conducted to show the value of absorption into the dressings and the method of securing it by free evaporation from the surface. A flask was filled to half its capacity with water, and a wick of absorbent gauze saturated with water was placed so that one end of the wick lay in the water and the other projected beyond the mouth of the flask so as to form a tuft. A fragment of some aniline dye was placed in the gauze level with the neck of the flask, and very soon the gauze tuft projecting beyond the mouth of the flask was stained with the dye. A similar experiment was carried out with, however, the addition of a bell jar placed over the flask to prevent evaporation; the addition of the bell jar not only prevented the aniline dye from rising into the projecting tuft, but the dye actually descended to some extent towards the water in the flask. I will not vouch for the accuracy of detail, but I attempted to repeat one of these experiments in the laboratory tent in our hospital here. I took two small flasks, each about one-third filled with water; I saturated wicks of gauze in water, and immersing one end of the wick in the water in the flask, the other end was allowed to project as a tuft beyond the mouth of each flask. I inserted a fragment of crystal violet in the gauze at the level of the neck of the flask; I then tied a piece of oil-silk as a cap over the top of one of the flasks, allowing the gauze tuft to project within this protective cap. After some hours the dye had risen into the tuft of gauze projecting from the unprotected flask; on the other hand, in the flask covered by oil-silk

the dye had failed to rise in the tuft, and had descended somewhat in the wick. This last flask was left overnight, and next morning the oil-silk was removed. Within an hour the dye mounted to the top of the tuft.

I have made many clinical observations as to the effect of impermeable dressings. I may cite one example: A woman was desperately ill with subphrenic abscess. I succeeded in establishing drainage, and her condition improved. Some ten days afterwards I was disappointed to find her temperature rising; the frequency of the pulse increased, and there was every evidence of a recrudescence of serious symptoms. I had not seen the dressing for a few days, and I found that the nurse had placed a large piece of oil-silk over my dressing in order to protect the bedclothes from getting soiled. I at once suspected the impermeable covering as responsible for the trouble, and therefore continued to apply the same type of dressing, with, however, the omission of the oil-silk. The patient improved promptly, and all symptoms of absorption disappeared. The sister in charge of the case, on my explaining what had occurred, made a somewhat shrewd observation. The sister told me that she had observed, when a moist piece of alembroth gauze (charged with aniline dye) was applied under oil-silk to the unbroken skin, the dye stained the skin deeply so that it could not be removed by washing; on the other hand, moist alembroth gauze without oil-silk never produced staining. This, indeed, is a good demonstration of the effect of impermeable coverings over the dressing.

The hospital with which I am at present connected has only been in operation some six weeks, and hardly a day passes but patients are admitted with impermeable coverings over septic wounds. In one a septic thumb had been opened two days previously, and when the patient came to me a piece of oil-silk formed a cap over the entire thumb; outside that was some wool and a bandage. Another man had a septic wound of the leg dressed with moist gauze held in place by a patch of adhesive plaster, which overlapped the gauze in all directions. We have already seen dozens of similar cases in our short experience here of the employment of impermeable coverings over moist dressings. We have been able to note, too, the prompt improvement on the omission of that covering in our dressings; frost bites with broken skin, shrapnel and bullet wounds—I am within the mark when I say that by far the majority of all septic wounds admitted have had an impermeable covering. The custom is unquestionably widespread.

What has tempted me most to write this note is the fact that so high an authority as Sir Almroth Wright advocates the use of impermeable protective over his dressing. This covering, I fancy, is added for some specific purpose, but its object is not stated and there has been nothing of similar character used in his laboratory experiments. It is true it increases the penetrating power of an antiseptic, but Sir Almroth Wright's avowed object is drainage, and beyond all doubt it is infinitely better to depend upon drainage into the dressing than attempt to render a wound aseptic by confining the discharges and driving the antiseptic in.

Impermeable coverings used for the purpose of preventing evaporation are, indeed, sometimes useful. Thus, in a healing ulcer one finds the healing process will proceed well under a moist piece of lint entirely covered by protective; so, too, one uses it in skin grafting. Such dressings are removed easily, they do not stick, and the delicate epithelium is not disturbed on taking off the dressing. The impermeable covering is often a favourite dressing, too, for the very reason that "it does not stick," and particularly in children one is tempted to use it because the dressing can be changed without pain. The cases, however, in which its use is justifiable are only those which are either aseptic or have a very small degree of infection—cases, in fact, comparable to those Sir Almroth Wright speaks of as capable of being closed by secondary suture. Even in these cases, however, we sometimes fail to secure success, and when employed we should carefully watch the results.

In my opinion the best dressing for septic wounds is a moist dressing, and we found the hypochlorous acid solution wonderfully effective. The moist dressing is applied directly to the wound, and over this dry gauze. Everything should be done to favour free evaporation from

the surface and absorption into the dressing, which should be frequently changed. I am convinced it would be greatly to the advantage of the wounded if impermeable protective and oil-silk were entirely removed from the surgical armamentarium of the army. Their use in surgery is very restricted, and as they are employed in military surgery at present they do far more harm than good.

REFERENCE.

¹ BRITISH MEDICAL JOURNAL, November 13th, 1915, p. 717.

Reports

ON

MEDICAL AND SURGICAL PRACTICE IN HOSPITALS AND ASYLUMS.

FULHAM MILITARY HOSPITAL.

SEPTIC COMPOUND FRACTURES.

At the fourth clinical meeting of the staff of this hospital, on January 11th, Dr. BELFRAGE opened a discussion on septic compound fractures due to gunshot wounds. He outlined the chief indications as follows: (1) Vigorous treatment of the sepsis; (2) the securing of comfort to the patient and ease of nursing; (3) early movement of the joints; (4) correction of deformity. He had found the ordinary splints of little use, and anticipated much help from Mr. Hey Groves's modification of Hodgen. He emphasized the desirability of paying more attention to obtaining a useful limb than to accurate apposition of the fragments. It was doubtful whether extension could be usefully employed in the early stages; later on the fragments could be adjusted under an anaesthetic.

Mr. CHAPPLE thought that in the arm the exact position of the fragments was often not of vital importance in securing a useful limb; but in the leg the necessity of parallelism for walking dictated the greatest care as to their position. He advocated operation where the disturbance of the fragments rendered it necessary, but in septic cases it was essential to wait until the sepsis had been dealt with before attempting plating. He also referred to a great truth established by Sir Arbuthnot Lane—that in dealing with a much comminuted fracture it was not necessary to get the whole circumference of the ends approximated. If a small portion were put in apposition the gap would be filled by new bone laid down if the after-treatment were suitable.

Mr. LEE said that generally there was too much haste to remove sequestra. They should be left till complete separation occurred, for frequently an apparent sequestrum proved to be a focus of new bone formation. He emphasized the importance in the treatment of sepsis of leaving, or if need be making, a very widely open wound; the surgeon should not meantime be too anxious about the displacement of the fragments.

Dr. CARNEGIE DICKSON, pathologist, referred to the extreme rapidity with which cancellous tissue might be absorbed to make room for active marrow in acute general diseases, and with regard to the duration of a septic focus, referred to a case in which a projectile had been removed six months after complete healing, and at the operation pus was found containing organisms of feeble vitality but still capable of growth.

Dr. KINNIE WILSON expressed the opinion that in some cases the late disability of muscular movement was greater than could be explained by mere disuse. Some cases were explicable on the theory that a defect was present in the reflex arc through the spinal cord. Possibly the constant afferent impulses from the diseased focus produced a dynamic functional change in the anterior horn cells and consequent muscular atrophy. Electrical treatment in such cases was more important than massage. Repeated efforts on the part of the patient sometimes sufficed to reawake innervation through the reflex arc.

The chairman, Major PARSONS, O.C., advocated putting up fractures under x-ray illumination. The prevention of movement in the injured tissues was of great value in limiting sepsis. The joint involved in a septic process required immobilization, while the other joints required to be moved. Continuous extension was valuable; often the weight applied was too small; attempts should be made from the first to rectify deformities. In treating sepsis

transverse incisions, which tended to remain gaping, were very important. The introduction of solid sodium chloride, which had given good results in France, should be tried, as also the introduction of solid urea, on which Professor Symmers of Belfast had reported favourably. He had obtained good results in septic conditions by Bier's treatment before the war and thought greater use might be made of it.

Reports of Societies.

THE DAILY FOOD RATION OF GREAT BRITAIN.

At the meeting of the Section of Anatomy and Physiology of the Royal Academy of Medicine in Ireland on January 14th, Professor W. H. THOMPSON made a communication on the daily food ration of Great Britain. He said that from a survey of the total food supply of Great Britain for the year of the first census of production (1908), the only year for which it was so far possible to make anything like an accurate computation, the daily food supply per *man* of the population, as calculated from the returns, came out to be as follows:

Flour and meal ...	14½ oz.	Cheese ...	½ oz.
Flesh meat ...	8 oz.	Condensed milk ...	½ oz.
Fish ...	2 oz.	Less than half an egg ...	½ oz.
Potatoes ...	15½ oz.	Fresh fruit ...	3½ oz.
Other vegetables ...	4½ oz.	Dried fruits and nuts ...	½ oz.
Milk ...	1 pint.	Cocoa and chocolate ...	½ oz.
Butter ...	1 oz.	Salad oil ...	1½ oz.

This ration provided the following:

Protein ...	101.49 gm.	Fat ...	136.36 gm.
Carbohydrate ...	587.12 gm.	Energy value ...	4,127 calories.

The returns did not, however, include all the home supply of cheese, eggs, poultry, or rabbit meat. The estimate of green vegetables consumed as human food, particularly of cabbage, was probably also too low. Making additions to cover these omissions, would bring the ration up to:

Protein ...	104.26 gm.	Fat ...	138.83 gm.
Carbohydrate ...	587.84 gm.	Energy value ...	4,167 calories.

As a fair estimate it would be safe to say that the British food ration per *man* per day does not exceed:

Protein ...	105 gm.	Fat ...	140 gm.
Carbohydrate ...	590 gm.	Energy value ...	4,190 calories.

Making deductions for loss in distribution, the value of the ration, as purchased, would approximately be:

Protein ...	97 gm.	Fat ...	129.5 gm.
Carbohydrate ...	546 gm.	Energy value ...	3,875 calories.

This did not provide more than enough for moderately hard muscular work. Dr. Langworthy placed the energy value of the ration, as purchased, for moderate work at 3,800 calories. The ration was remarkable in the relatively large amount of fat it contained, but in this respect it corresponded closely with the estimate of the German food supply before the war, as published by the Eltzbacher Committee. Professor Thompson drew two conclusions: (1) That the tendency in urban and industrial populations is to increase the consumption of fat at the expense of the protein; and (2) that the ration could not well be reduced without endangering the efficiency of the working man. Economy could, however, be introduced by substituting protein from vegetable sources for a further part of the more costly meat supply.

THE *Journal of the American Medical Association* states that 2,451 members of the medical profession in the United States and Canada died during 1915. The average annual mortality for the period from 1902 to 1915 inclusive was 15.71 per 1,000. The chief causes of death in order of frequency were senility, heart disease, cerebral haemorrhage, pneumonia, accident, and nephritis. The age at death varied from 21 to 102, with an average of a little over 59 years. The number of years of practice varied from 1 to 79, the average being 32 years 4 months and 26 days. There were 104 deaths from accident and 44 cases of suicide. Of those who died, 1 had been a member of Congress; 2 governors of States; 4 United States consuls; 11 members of State senates; 39 members of the lower houses of legislatures; 35 had been mayors; 33 aldermen, and 62 had served as justices of the peace, as clerks in the Government service, or in various other civil positions.