current views on applied physiology and pathology, would be less likely to lead to any miscarriage of justice.

Summary

A classification of deaths of medico-legal importance has been suggested. This classification is based upon the concept that tissue anoxia, however induced, leads to circulatory failure and death. Such a classification is considered to be more in keeping with current views in applied physiology and pathology.

It is emphasized that in the description of post-mortem findings for medico-legal purposes a clear distinction should be drawn between the basic pathological changes of circulatory failure and the special pathological changes characteristic of the particular type of death under consideration. Attention is directed to the fact that there are no qualitative differences in the basic pathological changes found in the different types of death.

Because of its convenience the term "asphyxia" is used extensively in the practice of forensic medicine. It is pointed out, however, that as asphyxia does not constitute a pathological entity it cannot be clearly recognized on the basis of morbid anatomical observations alone.

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SPECIFIC SERUM THERAPY IN TYPHOID FEVER

BY

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In normal times typhoid fever is relatively a rare disease, thanks to the forward strides in public health and bacteriology which have been made in the past half-century, and it is only when as a result of some unforeseen incident the disease assumes epidemic incidence that it attracts special attention. In the circumstances of war, however, opportunities for its appearance and spread are multiplied. Prophylactic measures go a long way in the protection of the individual and the mass in a modern army, and a supervised hygienic routine assists in averting the spread of infection. A very different state of affairs may be encountered when the present active warfare has ended and a continent in which for five years all the decencies and amenities of living have been disrupted presents itself; and infectious disease in the released peoples might constitute a major obstacle in the return to order. Among these infections the typhoid group of fevers may play an important part. Mass schemes must cater for housing, water, food, and the like, and inoculation will help in personal protection. "Inoculation," it must nevertheless be remembered, will not protect everyone to whom it is applied—a fact recognized by all who have studied and practised it. In our own Forces, so splendidly "serviced" on the medical side, there have occurred a certain percentage of failures to confer complete immunity to the particular disease against which defensive steps have been taken. In an article entitled "Military Medicine in the Middle East," Lieut.-Col. (now Brigadier) E. Bu'ner (1943), under the subheading "Enteric Group," says: "The 24 cases include typhoid, paratyphoid, and clinical typhoid fever, without laboratory confirmation. The low incidence is the result of the satisfactory state of the troops with respect to inoculation, but I have been impressed with the severity of the cases due to *Bact. typhosum*; inoculation did not seem to have modified the course of the disease once it was contracted. The mortality rate of 25% would be much higher if only cases of typhoid fever were considered. The disease remains uninfluenced by any treatment but good nursing, and the sulphonamide group is ineffectual."

Realizing that this case incidence, indubitably low though it is, is met with in a body of men so efficiently inoculated as are our troops, the potential incidence which might be encountered in the circumstances of starvation and disorganization in the immediate post-war Europe presents vast possibilities.

Hitherto medical treatment in the typhoid group has been mainly "general" and in a sense fortuitous and empirical, success resulting almost entirely from good nursing, as most clinicians will admit. In typhoid fever, but not in the paratyphoids, there is now at hand a potent therapeutic serum to which, in my view, too little general attention has been drawn. The work of Felix and his colleagues at the Lister Institute made possible the elaboration of his "Vi+O" anti-typhoid serum, in which, put briefly, two antibodies are effectively combined, the "Vi" element conferring protection by suppressing the multiplication of virulent strains of *Bact. typhosum* and the "O" antibody by neutralizing the endotoxin of that organism. Clinical trials of the new anti-typhoid serum have been reported from Palestine (Felix, 1935), Ireland (McSweeney, 1935, 1937), China (Robertson and Yu, 1936), England (Cookson and Facey, 1937), South Africa (Pijper and Crocker, 1939), Malaya (Landor, 1941), and the findings point definitely to its high therapeutic value, in particular in toxæmic patients. This serum has been used in the City Hospital, Fazakerley, since the beginning of 1938, and in that period 57 cases of typhoid fever have been admitted. Seven of these patients died, four deaths occurring within 80 hours of arrival at hospital. Twenty of the patients (of whom 4 died) were seaborne. These cases disembarked at the port are in the main of severe type, having been ill for varying periods at sea in circumstances in which, except in the largest liners, medical and nursing facilities of a standard available in a modern hospital ashore are not readily to hand. Those patients who on admission showed toxic symptoms—undue general prostration, hyperpyrexia, threatened delirium, coma or typhoid state, or complications such as haemorrhage or pneumonia—numbering 25 in all, received serum. Classified according to severity they were:

Very severe	..	..	..	..	..	12 (4 deaths)
Severe	..	..	..	..	..	9 (2 ")
Moderately severe	..	..	..	..	..	4

Seaborne patients contributed 14 of the 25 serum cases, and four of the six deaths, these latter being due to pneumonia (3), haemorrhage (2), and toxæmia (1). The one death in the non-serum group was the result of old-standing endocarditis in an elderly patient. The cases not receiving serum are, of course, not to be regarded as "controls," but rather as mild infections for which anxiety was not specially justified. All the patients were civilians who had not been inoculated with T.A.B. vaccine, and the clinical diagnosis was in each instance confirmed by bacteriological or serological examinations.

Though the number of cases reviewed in the series is not large and does not permit of assertive conclusions, the effects of serum treatment were manifest in three ways:

(a) Conditions due to direct toxæmia, excluding hyperpyrexia, abated rapidly, obvious improvement appearing often within 48 hours and continuing to be sustained, with coincident decrease in signs and increase of relative strength and well-being. Six of the very severe cases were of the type for which, in other times, but little hope of recovery could have been entertained; they responded with surprising and almost dramatic promptness.

(b) Hyperpyrexia was not affected in so quick a manner, a maintained fall in temperature taking some days and continuing as a moderately steep lysis.

(c) Incidental complications such as intestinal haemorrhage or pneumonia, already present when the patient came under treatment, did not seem to be influenced by the serum in any way. It was observed, however, that such conditions did not arise in the later course of the disease in those subjects to whom serum had been given in the initial and toxic phase.

The serum is issued in 33-c.cm. phials (Lister Institute), and injection of the contents of one phial intramuscularly (buttock) on three successive days, beginning at the earliest available moment, was routine. In the very bad cases an initial dose of 66 c.cm. was given. This may seem a large amount for one intramuscular injection, but if the serum and the syringe have been previously warmed and kept in water at blood heat

very little discomfort, and that of a transient sort only, is caused, and absorption quickly takes place. As experience in serotherapy in other diseases bears out, the generous dose of serum, especially if given early, brings a readier and more complete response than do smaller and repeated amounts.

All the patients except five in due time had an urticarial serum rash of variable intensity—a not unexpected event, as this serum is not of the “refined” type. In my personal view a simple serum rash alone is not a wholly ill-starred happening. Temporary and varying irritation is inevitable, but I have noticed in other diseases in which serum is used that, in certain patients who hitherto have seemed to be hanging fire, after the urticaria has come and gone improvement appears to be stimulated and accelerated, owing possibly, I have thought, to the ensuing leucocytosis and its added defensive mechanism—a condition to be desired in the leucopenic state of a typhoid fever patient.

I would add that while serum in typhoid fever seems to possess undoubtedly high value, its use does not in any sense minimize the prime importance of efficient nursing attention as an aid to the patient's recovery.

Summary

Clinical results following the use of Felix's “Vi+C” anti-typhoid serum are described. Its efficacy appears to be prompt and very satisfactory in those states due to pure toxæmia. Hyperpyrexia is diminished in time, but this change is not so rapidly brought about. Complications such as pneumonia and hæmorrhage, when present before the start of serum treatment, do not seem to be mitigated.

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Medical Memoranda

Prophylactic Penicillin

After a recent “incident,” many air-raid casualties were admitted to a hospital, including many with the usual grossly lacerated and contaminated wounds. As reports of the value of penicillin in preventing infection in battle casualties have been so favourable, five million units were speedily obtained by special messenger. Patients with more serious wounds were given 15,000 units (2 c.cm.) four-hourly by intramuscular injection, and, contrary to some reports, very few complained of the injections causing pain.* Previous experience of similar wounds led one to expect that infection of many of them was inevitable, even with the help of sulphonamides, but the absence of an inflammation in cases under penicillin control was astonishing.

Careful and thorough excision of a recent wound is, of course, the ideal procedure, but many of these cases, despite blood and plasma infusions, were in no condition to stand a time-consuming operation. In any case, some of the wounds were too deep and extensive for efficient débridement. The following is a typical case.

ILLUSTRATIVE CASE

A man aged 63, severely shocked, with multiple injuries, the most serious being a deep lacerated wound of the left buttock, from which blood was still trickling. This wound was plugged with gauze, and three hours later, after he had received two pints of blood and a pint of plasma, he was taken to the theatre. Exploration of the wound revealed extensive laceration of the gluteal muscles and comminution of the innominate bone in the region of the sciatic notch. From beneath the bony fragments a steady stream of arterial blood was escaping, presumably from the gluteal artery. As the condition of the patient precluded an extensive dissection to expose the torn vessel, efforts were made to seize it with forceps inserted beneath the bone, in the hope that diathermy applied to the forceps would thrombose the vessel. In any case, it was intended to leave the forceps *in situ* for a few days. However, efforts to seize the artery were unsuccessful, and, as the patient's condition was deteriorating, all that could be done was to plug the wound

with gauze moistened with flavine and to excise rapidly some of the damaged muscle. The first injection of penicillin was administered about four hours later, and subsequently at four-hourly intervals. It was anticipated that such an inadequately excised wound, in a very unfavourable situation, would become infected; therefore three days later the gauze was removed under general anaesthesia. To one's surprise and gratification there was no trace of infection—no redness of the skin, induration of deeper structures, or any discharge other than slight exudate of serum. Unfortunately, the arterial bleeding restarted on removal of the gauze, so replugging was necessary. Had it been realized that the wound was in a perfectly clean condition it would not have been interfered with. It is now proposed to leave the gauze plug *in situ* for several days, by which time the vessel should be occluded by natural means. If it is subsequently necessary to ligate the internal iliac artery the condition of the patient should have so improved that a major operation will cause little anxiety.

It appears that the bacteriostatic action of penicillin is so efficacious that in the near future, when supplies are available, its routine administration, time and circumstances permitting, will abolish the bogey of infection from traumatic surgery.

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Severe Fracture-dislocation of the Spine

This case is of considerable interest, as it shows a severe degree of fracture-dislocation of the spine in which practically complete recovery from paraplegia has occurred. Furthermore, the value of early suprapubic drainage is shown, as the restoration of bladder function was complete. It is also of interest in demonstrating how the spinal cord can escape damage in the presence of severe injury to the spinal column.

CASE HISTORY

The patient, a W.A.A.F. 22 years of age, was admitted five hours after her injury. She had been riding in a transport vehicle on duty when it suddenly overturned and fell down a slope. She had immediate pain in the back, and felt weak. Also she had no power in her legs. She was taken to the nearest hospital, radiographed, and given morphine. She was then transferred.

On admission the patient was pale, with a pulse rate of 100 and blood pressure 116/75; she complained of pain in the upper back

and of pins-and-needles in both legs. She had no power in the legs and was unable to pass urine. General examination revealed the following abnormalities. The bladder was palpable 2 in. above the umbilicus. The knee-jerks, ankle-jerks, and plantar responses were absent. Abdominal reflexes were normal. There was no movement below the knees, and no movement of the left quadriceps. She could tighten her right quadriceps and slightly adduct both thighs.

Sensation was normal down to the level of the eleventh thoracic nerve supply. She was hyperaesthetic to pin-prick at the level of the twelfth thoracic nerve, and below it she had diminished sensation to pin-prick and touch on both sides; there was no sensation on the sole of the left foot and left calf. Radiographs showed a severe fracture-dislocation of the twelfth thoracic vertebra (see Fig.).

Treatment.—The patient was first treated on a sorbo mattress, which was discarded on the fifth day for a plaster bed, in which she was more comfortable in every way, as small movements on the mattress caused considerable pain. Suprapubic cystostomy was

* When time and facilities permit, it is probably better to give penicillin by continuous intramuscular or sternal drip. One hundred thousands units a day sustains an adequate concentration of penicillin in the circulation.