to moisture. In the case of products like plasma this is not significant, but with others which have a low content of solids it is highly important to give consideration to the amount of moisture going through the stopper.

For example, compare a 10-ml. amount of serum with a 300-ml. amount of plasma. If, under certain conditions of long storage, the 10 ml. of serum will be taken up to 8% moisture content, the 300-ml. amount of plasma will have its moisture content increased only by one-thirtieth of this—by about 0.27%. The reason is that there are 30 times as much solid matter by weight in the plasma container as in the small serum container, yet the amount of moisture permeating the stopper is the same. With penicillin, where the amount of solids may be only one-fifth as great as even in the 10-ml. quantity of serum, the moisture content could go as high as 40% (Flosdorf *et al.*, 1945).

Other Methods of Drying

As indicated above, the stability of penicillin is such that it may be evaporated as a liquid at room temperature without undue loss of potency. Recently, pre-concentrating dilute penicillin solution in bulk by means of dielectric heating in low-vacuum apparatus has been carried out successfully. This reduces appreciably the load on the equipment for final desiccation from the frozen state, particularly if the original penicillin solutions are quite dilute. After pre-concentrating in bulk in this fashion, the liquid product is distributed to phials in which the concentrated penicillin is frozen and then dried by sublimation.

It may be that before long it will be possible to dry the concentrated solutions of penicillin as a second step by means of dielectric heating on a practicable basis in the final ampoules. The reduction to a final moisture content of 0.5% must be accomplished as a third step in which a warm bath is used to heat, since the dielectric means become ineffective on the dry penicillin. The final product is less attractive in appearance. Solubility is slower, but fast enough for the purpose. The matter will then resolve itself simply into one of economy in handling a large number of ampoules in the second and third steps required with dielectric heating as compared with drying by sublimation.

Summary

Problems met in drying penicillin in contrast with those with blood plasma and other products are discussed. Procedures used in large production are described. Final moisture requirements and types of containers suitable for penicillin are discussed. Use of dielectric heating of penicillin is considered.

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The Research Board for the Correlation of Medical Science and Physical Education, which was formed in 1943 under the chairmanship of Brig. F. Howitt, has issued a first interim report. The material is arranged in four chapters, on maternity and child welfare, education and recreation, the Services (the normal recruit, the sub-standard recruit, and the sick, injured, and disabled), and a note on the work of the Industry Subcommittee by Brig. F. A. E. Crew. There is a foreword by the chairman, and the report concludes with some recommendations. Copies may be obtained from the Ling Physical Education Association, Hamilton House, Bidborough Street, W.C.1, price 2s. (postage 3d.).

GAS GANGRENE AFTER SECONDARY SUTURE OF SHELL WOUND OF THIGH

BY

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I am led to report this case for two reasons: (1) the fact that the gas gangrene followed secondary suture of the shell wound of the thigh; and (2) the fact that the patient recovered after apparently being moribund.

The former occurrence was most disconcerting, as the patient was very fit before the operation and, clinically, the wound looked healthy and suitable for suture and the swab was sterile. Many cases of gunshot wounds had been submitted to secondary suture, and this was the only one which caused any anxiety—all the others were successful. But it is important to record failures or accidents as well as successes. And, as Sir Ernest Rock Carling, with whom I have been in communication, remarks, "one accident does not vitiate the principle, and secondary suture is extremely important." It emphasizes the necessity for taking swabs not only from the surface but from the recesses of the wound. Apparently the organisms had been lurking just beneath the surface.

With regard to the latter occurrence, I have never in all my experience seen a patient so ill recover. I asked Prof. F. C. Pybus to see him with me, and we both agreed there was no chance of recovery. It shows that "where there is life there is hope."

Case History

On June 23, 1944, Capt. X., aged 30, and the crews of two tanks were resting beside their vehicles when a German shell burst near them, wounding seven men, including the captain. Assisted by another officer, he dragged the wounded men into slit-trenches, which were dug in the well-cultivated orchard of a French peasant. Capt. X. forgot to apply his field dressing to his wound, which became contaminated with soil. An hour after the bursting of the shell he was admitted to the regimental aid post with a lacerated wound of the skin and muscles of the right thigh, on its anterior aspect, the wound being about 4½ in. long by 2 in. wide. At No. 3 Casualty Clearing Station later that day the wound was found to be widely open but not suitable for surgical treatment, so it was dressed with sulphanilamide powder and vaselined gauze, and a back splint was applied. Two days later, in hospital, the splint was removed, as it was causing pain, and the wound was re-dressed. The patient's general condition was very good. Between the 23rd and 29th he received 3 c.cm. of A.T.S. and 20 g. of sulphanilamide.

On the 29th he was admitted to the Royal Victoria Infirmary, Newcastle-upon-Tyne, under my care. His general condition was still good. The wound of the thigh was rather dirty and putrid, and of a greenish colour. A swab was taken from the wound, and this produced cultures of mixed penicillin-sensitive organisms. Two days later another swab showed streptococci suitable for penicillin treatment. The patient complained of pain on micturition and frequency but no discharge.

On July 6 the wound was cleaner, and not everted so much. There was a very scanty colourless exudate. Dressing was done with penicillin powder and tulle gras, and the wound became cleaner and healthy-looking. A swab showed it to be sterile, so it was decided to carry out secondary suture. This was done on July 14, the edges being undermined and the skin approximated with silkworm-gut sutures. Proflavine and sulphanilamide powder were dusted into the wound. Next day there was a slight amount of serum oozing from the lower part of the wound.

On the 16th there was slight tenderness round the wound; some blood-clot was oozing, and this reappeared when cleared away. His pulse was 120, his temperature normal, and he was fairly comfortable. Some sutures were removed. By the next day a large amount of clot was escaping from the wound. The remaining sutures were removed and masses of foul-smelling clot evacuated. There was oedema over the knee and thigh, and the leg was very tender. His pulse was 108 and temperature 99° F. He was in pain and looked ill. A few bubbles of gas escaped from the wound. An intramuscular penicillin drip was set up in the left thigh. Sulphathiazole was given, together with 12,000 units of anti-*Cl.-welchii* serum, intravenously. That evening 22,500 units of polyvalent serum were administered. A blood drip was started at 09.30 hours, but by 10.30 hours a severe reaction to the A.G.G.S. took place, characterized by respiratory distress, vomiting, and urticaria. The blood drip was stopped as a precaution. The patient was gravely ill the whole day. A swab showed the presence of clostridia other than *welchii*, with sensitive *Staph. albus* and resistant faecal streptococci.

The next day (the 18th) he was still very gravely ill, his temperature being down to 95° F. and his pulse up to 150, thready and barely palpable. He vomited altered blood, the vomiting being effortless. A duodenal tube was passed and was left *in situ*. The output of urine fell almost to zero, and he was pale, grey, and sweating, and looked like dying. The oedema had spread up from the thigh on to the abdomen, back, and lower part of chest. In the evening, as a last resort, multiple incisions were made in the thigh, back, and abdominal and chest walls. Considerable quantities of serum and a little gas escaped. A saline-sulphathiazole drip was started—3/4 pint in four hours. On the 20th he was still ill, but his pulse had fallen from 140 to 108 and its volume was better. His temperature had risen from 95° to 98° F. and the amount of urine excreted had increased. In addition to getting whole blood he was having intravenous saline and dextrose most of the time. A swab taken on the 22nd was sterile and the patient continued to improve, his chest being clear and free from pulmonary oedema. The next day he developed a mild phlebitis of the left leg. The drip was discontinued.

During the following week he received two pints of fresh blood and polyvalent A.G.G.S. The penicillin drip was continued. On the 27th his haemoglobin content was 59%. All this time there was a copious serous discharge from the wounds, and precautions were taken to give plenty of fluids by mouth or intravenously. The serum protein was investigated, and showed total protein 5.40%—albumin 3.12%, globulin 2.28% (by difference). An area of redness and swelling developed on the inner side of the right thigh, so on July 30 more multiple incisions were made, but only blood and serum exuded. This process was repeated a few days later. The swelling of the thigh and leg gradually subsided. On the 31st his haemoglobin had fallen to 52%, so more fresh blood was given, and it rose to 58% by the next day. A swab showed scanty *Staph. aureus*, enterococci, coliforms, and Gram-positive bacilli. A swab taken three days later revealed Gram-positive cocci, scanty Gram-positive bacilli—probably anthracoids—and some resistant staphylococci and enterococci.

By Aug. 6 his haemoglobin was 65% and he continued to improve. The serous discharge from the wounds diminished—in fact, most of the wounds were now healed; but there was a discharge of pus containing bubbles of gas from a few of the wounds above and below the original shell wound and the thigh was distinctly resonant on percussion in these situations. It was decided to operate again, and on Aug. 25 the wounds were opened up and from each site, above and below the original wound, a large grey-black spongy slough was removed. The pathological report on these specimens was: "The material consists of two masses of soft friable tissue 5 × 2.5 × 1 cm. and 9 × 5 × 1.5 cm. The material is necrotic, and muscle is not recognized. Microscopically this is completely necrotic. Adipose tissue is the only recognizable one in the section." The patient improved rapidly after this; the wounds (operation and shell) healed completely and he was allowed up. He was discharged to his home on Sept. 28. All the movements of the limb were complete, but there was, of course, wasting of the muscles and he walked with a limp. His general condition was good.

During the course of his illness more than three dozen incisions were made in the thigh, back, abdomen, and chest. He had been given nine pints (900,000 units) of penicillin solution intramuscularly and about 150,000 units of anti-gas-gangrene serum as well as a second full course of sulphonamides. In addition he had large quantities of blood, plasma, saline, and dextrose intravenously.

I acknowledge my indebtedness to the resident medical officer of the Royal Victoria Infirmary, Dr. J. H. Craig, who was responsible for the intravenous therapy and whose interest in the case contributed largely to the happy ending.

The latest report of Dr. H. P. Newsholme as medical officer of health for the City of Birmingham shows that the year 1943 gave cause for satisfaction in a number of aspects of the public health. New records were reached in an unusually large number of directions. The year saw the lowest infant death rate ever recorded in the city; and, with this, the lowest illegitimate infant mortality, falling actually below the particularly low general infant mortality. The city recorded its lowest neonatal death rate for infants under 1 month of age, and its lowest stillbirth rate. The year showed also the lowest notification rate of non-pulmonary tuberculosis so far recorded in Birmingham; last, but not least, the lowest maternal death rate ever recorded in the city was reached in 1943. Against these pleasant facts Dr. Newsholme notes that, largely as a result of a widespread epidemic of influenza, the death rate did not drop quite to the low level of 1942; that there was a 35% increase in the number of new cases of syphilis coming up for clinic treatment; and that there was some increase, though not a large one, in new cases of tuberculosis of the lungs in 1943. No substantial change occurred during the year in the housing position, and the problem of overcrowding as well as that of families housed in dilapidated property remains very serious.

TWO CASES OF TETANUS

BY

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The first of these cases of tetanus is described because it is an interesting example of severe local tetanus developing during the course of a mild generalized attack; and the second—a straightforward example of severe tetanus—because it illustrates certain special points in treatment.

Case I

On Aug. 8, 1944, the patient, a boy aged 5½, trod on a rusty nail, injuring the left foot. No special treatment was given, and the wound appeared to heal satisfactorily. On the evening of Aug. 11 he seemed generally out of sorts and complained of abdominal pain, which woke him up every hour throughout the night. In the morning he had difficulty in opening his mouth. He was admitted to Addenbrooke's Hospital on Aug. 12, about 16 hours after the onset, and then showed the characteristic signs of tetanus: trismus, risus sardonicus, stiffness, opisthotonos, and abdominal rigidity. The foot and leg on the injured side were slightly stiffer than on the other. On the ball of the left big toe was an almost healed wound with no sign of sepsis. There were no other wounds.

Treatment and Prognosis.—200,000 units of antitoxin were given at once, mainly by the intravenous route, and during the next few days trismus and rigidity of the trunk increased. On the 13th reflex excitability increased, and on the 14th he had some slight generalized spasms. Synchronously with the development of these general signs, the rigidity of the left leg became steadily more severe, and by the 14th the whole leg, in contrast to the other limbs, was in continuous muscular spasm and so stiff and rigid that to produce even slight movement at the knee- and ankle-joints required the exercise of considerable force. The leg was slightly flexed at the knee, with the foot plantar-flexed and inverted (see Fig.). Very slight reflex spasms

CASE I.—Local tetanus, left leg and foot.

occurred several times daily until the 17th, and tonic rigidity of the trunk and trismus until the 31st. A severe degree of stiffness of the left leg remained throughout the whole illness, and the left foot was still rather stiff on Sept. 9, when the patient was able to walk about. All stiffness, both local and general, had passed off when he was discharged on Sept. 25.

At no stage of the illness were the spasms severe, and 10 gr. of potassium bromide four-hourly and 1½ dr. of paraldehyde per rectum once nightly for the first five days were sufficient to promote sleep.

Case II

On Sept. 17 a boy aged 8 fell off his bicycle, grazing the dorsum of his right foot. This was treated with dettol and bound up, but the wound was not kept very clean. On the evening before admission he felt generally out of sorts and complained of severe backache and difficulty in opening his mouth. These symptoms became rapidly more severe, and he was admitted to hospital on Sept. 27. On admission risus sardonicus and trismus were pronounced, and he could only separate the teeth a quarter of an inch. There was also severe rigidity of the whole trunk with slight opisthotonos. There were a partly healed septic abrasion on the right external malleolus and other scabs on the right heel.

Treatment and Prognosis.—On admission 100,000 units of antitoxin were given intravenously, and the wound was subsequently cleaned and scabs were removed. The signs increased rapidly in severity, and 24 hours after the onset reflex excitability was becoming extremely marked, and, 36 hours after, generalized convulsions were occurring regularly every half-hour, with very severe trismus. Other ominous signs were a rising pulse rate and temperature and inability to take food because of the severity of the trismus. There was also considerable difficulty with micturition.