DISINFECTION OF THE NASO-PHARYNX OF MENINGOCOCCUS-CARRIERS

BY MEANS OF AIR SATURATED WITH A SOLUTION OF DISINFECTANT.

BY

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Preliminary Note.

THE following experiments were made for the purpose of determining whether persons carrying the meningococcus in their naso-pharynx can be freed of that micro-organism by causing them to inhale the air of a room saturated with vapour containing a disinfectant. The disinfectant used in these preliminary observations was chloramine.

For the present, attention has been confined to obtaining answers to the three following questions:

1. Does the air of a room when saturated with water vapour containing chloramine exert bactericidal properties?
2. If so, to what extent can such air be tolerated by human beings?
3. Is the method a practical one for the purpose of destroying the meningococcus in the naso-pharynx of carriers?

I. The Bactericidal Value of Chloramine Vapour.

The experiments have all been carried out in the same room, which has a capacity of approximately 1,050 cubic feet. This room was bare save for a few chairs and a table, on which the spraying apparatus was placed.

In an investigation of this kind, when air is charged with disinfectant in the form of vapour, it is desirable to be able to read off the amount of water vapour present in the air at any given moment. Throughout the experiments, therefore, a dry and wet bulb thermometer was suspended from the ceiling of the room so that the degree of humidity of the air could be observed and any departure from the saturation point perceived at once.

Sprays Tested.

(1) *The Wassmuth Spray*.—At first a specimen of this spray obtained by Captain Martin Flack, who has co-operated throughout in these experiments, was tried. The spray in question, however, was found to be far too small to be of use for the present purpose.

(2) *Lingner's Spray*.—An example of this apparatus was kindly lent to us by Dr. A. E. Thomas, Medical Officer of Health of Finsbury, and used in all the experiments. The Lingner spray, originally designed for disinfecting a room with formalin vapour, consists of two essential parts. The first of these is a ring shaped copper boiler, in form not unlike a bicycle tyre, fixed immediately over a circular trough which is filled with asbestos wool moistened with spirit. From the boiler three pipes convey steam centrally to a chamber of about two litres capacity, in which the solution of disinfectant is placed. The roof of this chamber carries a safety valve and four spray nozzles which point vertically upwards. In practice the boiler of the spray is first filled with 1,500 c.cm. of water, and then the disinfectant chamber is charged with 1,500 c.cm. of solution to be tested. Owing to the powerful nature of the burner, and to the efficiency of the boiler, the sprays begin to work within about ten minutes of lighting the burner. The dry bulb temperature of the room rapidly rises, followed by that of the wet bulb. In about ten minutes after the sprays have started (that is, twenty minutes after lighting up), the temperature of the two thermometers becomes equal, indicating that the air is saturated.

Owing to the comparatively small size of the instrument the sprays in the Lingner apparatus cease work after running for about forty minutes. Thus the air of the room could not, with this apparatus, be kept saturated with the disinfectant vapour for over twenty minutes.

In the following experiments, therefore, the Lingner apparatus was first of all charged with enough spirit, water, and disinfectant respectively to produce a preliminary saturation of the air of the room. The apparatus was then rapidly recharged, and when the two thermo-

meters suspended in the air of the room had for the second time become equal, the plates were exposed for the periods stated.

Mode of Determining the Bactericidal Action of the Air.

The procedure was as follows: *Staphylococcus epidermidis* was used as the test micro-organism. This staphylococcus is easily obtained by the simple expedient of rubbing a little broth on the skin of the hand, and then distributing a loopful of this skin washing over an agar slope.

A capillary pipette was charged with a series of equal volumes of a young broth culture of the skin staphylococcus, the units of broth being separated from each other in the pipette by air bubbles in the manner advocated by Wright. Each of these equal amounts of broth culture was then expelled in turn on to a separate agar plate, and distributed over its surface by a sterile bent iron wire. Thus an equal amount of staphylococcus was sown on each plate. In all the tests one of the plates inoculated with the staphylococcus in the manner described was kept as a control to show that a culture of living cocci had been employed. In all of the experiments also another of these plates was directly exposed for a moment to the spray itself, so as to determine whether or no this was immediately bactericidal. The remaining plates of the staphylococcus were exposed to the air of the room after it had become saturated with the vapour of the antiseptic. These plates were exposed to the air in one of two places—namely, (1) on the table near the spray but not visibly sprinkled by it; and (2) as far away from the spray as possible—that is, on the ledge of a window fixed in the outer wall of the room.

Results.

The outcome of six experiments made in the way described may be summarized as follows:

- (1) The temperature at which the air of the room became saturated varied in the six experiments from 77° F. to 85° F.
- (2) In all of the experiments the control plate showed a profuse confluent growth of the staphylococcus.
- (3) The strength of the chloramine solutions tested varied from 1 to 5 per cent. The spray was not found capable of destroying the staphylococcus immediately when it contained less than 1.5 per cent. of chloramine.
- (4) When 2 per cent. of chloramine was used in the spray, the plates both on the table and on the window-ledge were partially sterilized in five minutes, and completely so in ten minutes. Below this amount of chloramine, present results are contradictory and the experiments are being repeated.
- (5) As regards toleration, air saturated with moisture from a spray containing 5 per cent. of chloramine is distinctly trying, and after two or three minutes painful. Air saturated with vapour from a spray containing 2 per cent. of chloramine, however, is easily tolerated for at least five minutes on first acquaintance with it. Some can put up with this air for twenty minutes or longer. A promising feature of these experiments with vapour containing chloramine is that one soon becomes accustomed to it, tolerance being speedily raised.

II. Trial of Air Saturated with the Vapour of a 2 per cent. Solution of Chloramine upon Carriers of Meningococcus.

In view of the pronounced bactericidal action which air containing chloramine vapour had thus been proved to possess for the staphylococcus, no less than by reason of its comparative innocuousness to human beings under the conditions tested, the effect of such air was now tried upon persons carrying the meningococcus in their naso-pharynx.

CASE I.

The first case was that of a clergyman who had become a carrier as the result of attending a soldier suffering from cerebro-spinal fever in a military hospital. Owing to the true nature of the disease from which the soldier was suffering not having been realized until he was dead, no special precautions had been taken. This gentleman happened to call when the investigation had reached the stage just referred to, and as he was most anxious to be

freed of the meningococcus, the opportunity was taken of determining the effect of the air of the chamber upon the meningococci in his naso-pharynx. His naso-pharynx having been swabbed, he put on a mackintosh and entered the chamber where the air was saturated with the vapour of a 2 per cent. chloramine spray and gave a dry and wet bulb reading of 78° F. He stayed in the chamber for six minutes, with a staphylococcus plate exposed near him, and during the whole of this time vigorously inhaled the air through his nostrils. After leaving the chamber his naso-pharynx was very thoroughly reswabbed.

The result was as follows: Before entering the chamber his naso-pharynx gave a profuse growth of meningococcus colonies. After leaving the chamber his naso-pharyngeal secretion gave no growth whatever of meningococcus. Only a few colonies of any kind grew; and they were colonies of streptococcus.

The agar plate sown with staphylococcus and exposed to the air of the chamber during his sojourn there, showed a 99 per cent. reduction of this micro-organism as compared with a control plate.

Two days later the naso-pharyngeal secretion of this case was re-examined and the meningococcus was found to be again present. After fifteen minutes' sojourn in the chamber, however, his naso-pharyngeal secretion was found to be again free of it. After a further interval of two days, examination of the naso-pharyngeal secretion failed to show the meningococcus.

CASE II.

A staff sergeant who was also carrying the meningococcus in his naso-pharynx was exposed in a similar way to the air of the chamber saturated with the vapour of a 2 per cent. solution of chloramine. He was able to stay in the chamber for twenty minutes, and could have stayed longer had it been thought advisable. While he was in the room, four agar plates sown with staphylococcus were exposed. The first two plates were closed and removed after ten minutes' exposure, the others remained open for the whole time that he was in the chamber.

The result of this test was as follows: Before entering the chamber, the naso-pharynx of the staff sergeant yielded fairly numerous colonies of the meningococcus; but this organism was not so abundant as in Case I. After leaving the chamber, no colonies of meningococcus could be grown from his naso-pharyngeal secretion which, however, showed a fair number of colonies of other organisms.

All four plates sown with staphylococcus that were exposed to the air while he was in the chamber gave no growth. As two of these plates had only been exposed for ten minutes, it is clear that the staphylococcus had been destroyed within that time.

On the following day the naso-pharynx of this case was re-examined and meningococcus found to be absent. The treatment, however, is being continued.

Conclusions.

These preliminary observations furnish the following answers to the three questions formulated at the beginning of the paper:

1. The air of an ordinary room, when brought to the point of saturation by means of a steam spray containing 2 per cent. of chloramine, acquires pronounced bactericidal properties for *Staphylococcus epidermidis*.

2. Such air can be tolerated by human beings for a period varying from six to twenty minutes without marked discomfort and without harm.

3. When inhaled through the nose, this air succeeds temporarily in destroying the meningococcus in the naso-pharynx of carriers. Its sphere of usefulness in this and other respects is being more closely investigated.

In view of the simplicity and convenience of the method and its obvious suitability for the purpose of dealing with a large number of carriers at a time, the above results are encouraging. That such a mode of treating meningococcus carriers has prospects of success may also be inferred from the statement of E. Kuster (*Deut. med. Woch.*, September 9th, 1915) that during an outbreak of cerebro-spinal fever at Cologne early in 1915, meningococcus carriers were freed of that micro-organism by exposing them in an "inhalatorium" to an atmosphere impregnated with Sano's fluid, the active principle of which, like chloramine, is a compound of hypochlorous acid.

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PARALYSIS OF THE INTESTINE AFTER RESECTION FOR GUNSHOT INJURIES.

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This serious complication seems to occur only in the small intestine. It consists in the paralysis and distension of the gut immediately above the junction which is made after removal of an injured coil. The distension ends sharply at this point, and the bowel below remains in a contracted and apparently healthy state. If unrelieved, the condition is rapidly fatal in the same way as any other form of acute obstruction. It may occur either in cases operated on after a considerable interval, or in those which have been dealt with within a few hours.

In cases in which operation has been delayed it is easier to understand. It is now recognized that injury to the small intestine is not as a rule accompanied by any considerable escape of contents, and such escape as does occur is not progressive, as it is in the duodenum or large intestine. The wounded coil has been found, even two or more days later, adherent or surrounded by omentum, inflamed, and full of liquid faeces which do not escape into the general cavity till the coil is disturbed at operation or autopsy.

In a case of this kind, where peritonitis is purely local, the bowel below the injury is found contracted and apparently normal; that above, in consequence of the obstruction caused by the injured coil, is distended, paralysed, and poisoned. In this it resembles the bowel above any acute obstruction of some standing, and, if it has been long in this state, it is only to be expected that, even after removal of the injured portion, it should fail to regain its functions for some considerable time.

A case of the kind already published¹ may be referred to briefly.

CASE I (O. R.).

The patient, who had been shot two and a half days previously, presented pain, rigidity, bilious vomiting. The small intestine was wounded in two places; the wounded coil was full of liquid faeces, of which none had escaped; 12 in. resected, end-to-end anastomosis made, and the bowel above emptied. Next morning the patient was better, but later bilious vomiting recurred, and he died in thirty-six hours.

Post-mortem Examination.—No other injury; no general peritonitis; no free blood. The bowel above the junction very much distended, that below it empty and contracted.

If in this case, in addition to the coil actually wounded, the intestine above it, which had borne the brunt of two and a half days' acute obstruction, had been freely removed till more healthy gut was reached, it is possible that recovery might have resulted.

The deliberate removal of distended bowel for some distance (2½ ft., 4½ ft.) above an injury was, in fact, followed by recovery in two subsequent cases¹ of this kind of eighteen and thirty-six hours' standing respectively.

But it is clear that when a patient is operated on, as is now frequently possible, within a few hours of receiving his wound, these considerations do not apply. There has not been time for the bowel above to become permanently damaged from this cause. Nevertheless, we have each of us recently met with instances of this complication arising in cases operated on within seven and eleven hours respectively.

CASE II (J. F.).

Pte. G. W. was admitted to hospital six and a half hours after injury, suffering from a bullet wound in the abdomen, which had entered below the umbilicus and passed out below the left buttock. Operation showed extensive damage to 9 inches of the lower end of the ileum; 12 inches were resected and an end-to-end anastomosis made. During the forty-eight hours subsequent to operation the patient made good progress. Sickness and abdominal distension then appeared. The obstruction became progressively worse, and the abdomen was opened a second time under spinal anaesthesia. A clot of blood was found in the mesentery in