Holmes (H.)

OXYGEN IN CHOLERA:

A Letter on that Subject

TO EVERY MEMBER OF THE PROFESSION.

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BY

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SIR,

YOU are doubtless aware that an official Report has lately been made to the President of the Board of Health, by a committee of gentlemen appointed to inquire into the results of the different methods of treating Cholera.

That Report has now gone forth to the profession and the public with the impress of authority, and whether we regard the broad basis of well-collated statistics upon which it rests, or the zeal and talents of the gentlemen who have drawn it up, its great practical value can hardly be overrated, and its conclusions may justly be expected, (in the absence of further light), to form the rule of all future treatment.

Those conclusions, I would briefly remind you, are,—

1. That the astringent principle, as represented by chalk, laudanum, &c., has been by far the most successful in the general run of cases.

2. That the alterative and astringent principles combined, as expressed by calomel and opium, have been most efficacious in bad cases.

3. That the stimulant principle, of which brandy, ammonia, ether, &c., stand chief symbols, has been attended with a mortality of 54 per cent. And—

4. That the *latest improvement*, the "eliminative" method, of which castor oil is the representative, returns 71·7 per cent. of deaths.

This, then, is our statistically-ascertained position, as regards the treatment of Cholera. We are just where we were a quarter of a century ago. Our old familiars, calomel and opium, chalk and laudanum, are our sheet-anchors now as then; and prospect of im-

provement there is little or none, for we are bound to assume the conclusions of this most competent Report, as the legitimate foundation of future practice.

The position is grave in the extreme, whether we regard medicine as a science, healing as an art, or human life as a great charge committed into our hands; and a due sense of its gravity is the best apology I can offer for addressing you in the present direct form, and soliciting your candid examination of the views which I have now the honour to lay before you.

Avoiding all speculations upon the various alleged causes of Cholera, the nature of the assumed Cholera poison, &c., &c., which are as yet intangible abstractions, it hardly admits of question, that the four great principles which represent the entire treatment of Cholera in the Report, answer strictly to the morbid conditions and remedial indications of the disease, even in its worst forms; and if this be so, we can only explain our want of success by an arbitrary division and isolation of those principles from one another, or the inefficiency of the means we employ as their therapeutic exponents. Thus—

1. The primary importance of arresting that fearful drain, which, from its effects upon the blood, is so generally believed to be the immediate cause of all the other symptoms, can only be doubted by those gentlemen who entertain erroneous notions respecting the true form and manner of applying the eliminative principle; and here a more powerful and certain astringent than opium, &c., seems to be the only desideratum.

2. The equal necessity of altering those conditions of the blood—mechanical, chemical, and vital, which constitute the grand pathological feature of the Cholera collapse, none will deny; but whether, under the peculiar circumstances, mercurials and salines are the proper instruments, is more than doubtful.

3. Stimulation—prompt, potent, and if possible, permanent—is urgently demanded by the general and appalling failure of all the vital powers and manifestations; but it is clear to me that brandy, ether, and the other hydro-carbons, &c., we usually employ, are directly calculated to aggravate that smothered and poisoned condition of the blood, of which this symptom is pathognomic, and which calls for fire, rather than fuel, as the true stimulant. And—

4. Elimination—whether of the assumed Cholera poison or not—is certainly a principle which ought to be applied to those morbid elements which the liver, kidneys, and, to a great extent, the lungs, have ceased to separate from the blood, and which are accumulated to a poisonous degree in the circulation, or rather stagnation, of that fluid in collapse; but if such elimination can be accomplished by the combustion of these poisons, and the reactionary movements which attend it, few will think of resorting to purgation to achieve the same object.

Now, if the phenomena of collapse, stereotyped in all our memories, and the post-mortem evidence that has been collected in all places and at all periods of our acquaintance with it, prove anything, they prove this,—that it is, so to speak, *an universal asphyxia*, a condition of the blood in which normal oxygenization is impossible, and hence all the essential symptoms of collapse are more or less directly referrible to privation of oxygen, and arrest of those vital actions which depend upon that great element.

Our common belief that the unnatural spissitude of the blood, caused by the loss of such large quantities of its serum, is a mechanical obstacle to oxygenation, is abundantly demonstrated by facts. The thick, tarry, or treacly condition of blood obtained by venesection (if, indeed, we can so obtain it at all), need only be looked at in connexion with what we know of the physiology of the blood-changes in the pulmonary capillaries, to show how utterly incompatible with normal oxygenation such a condition is.* This again is proved by the experiments of many observers, which show that the small and constantly decreasing volume of air entering the lungs in collapse, is returned comparatively unchanged, little or no carbonic acid being exhaled, because little or no oxygen is absorbed. Moreover ,the effect of aqueous injections into the veins, in restoring the blood to its natural consistence, and thus enabling it to permeate the capillaries of the lungs, is at once attested, by the evidences of oxygenation and reaction which *immediately* and *invariably* ensue. Lastly, examination of the lungs of those who die of collapse shows that, in most cases, the blood has not, towards the last, even entered the pulmonary capillaries, but has been arrested at the smaller divisions of the pulmonary artery; and thus the circulation between the right and left sides of the heart is ultimately cut off before reaching the point of contact with the atmosphere, and the lungs are often found like those of the fœtus—pale, collapsed, non-crepitant, without air in the cells, or blood in the capillaries surrounding them ; this circumstance distinguishes the pathology of choleraic asphyxia from all other forms of asphyxia whatsoever.

That the phenomena of collapse result directly from non-oxygenation, and non-oxygenation from the mechanical condition of the blood,† is thus clearly made out.

1. By the condition of the blood obtained by venesection.

2. By observations on the quantities of air inspired, and chemical composition of the cold breath expired in collapse.

3. By the *constant* effect of aqueous injections in thinning the blood and restoring oxygenation.

* If we believe the blood-globules to be the normal oxygen-carriers, how is the function of these delicate bodies situated in blood of this consistence ?

† The mechanical view of the cause of non-oxygenation does not at all interfere with the chemical, which shows, on very good evidence, that the minute arteries have a tendency to contract to an unusual degree under the irritation of poisoned blood : choleraic blood presents both the mechanical and chemical causes of arrest of the capillary circulation in perfection.

4. By the post-mortem condition of the lungs and arterial and venous systems.

To the same cause which prevents the absorption and transmission of oxygen, is clearly attributable the arrest of those secretions which are formed under the influence of that gas, and indeed, of all those vital actions of which the systemic capillaries are the great arena; and thus the circulation becomes choked with the unconsumed elements of respiration, the uneliminated constituents of bile and urine, and the unchanged *débris* of effete tissues; and the blood having arrived, both chemically and mechanically, at a *dead-lock*, we have hopeless collapse—life itself is collapsed at its fountain and in all its streams.

This, I humbly maintain, is not a state of things to suggest the introduction of more carbonaceous principles into the blood, as stimulants, nor of harmless doses of mercurials or salines, as alteratives, and still less to warrant the elimination of more serum by purgatives. But if we can concentrate the stimulant, alterative, and eliminant principles of treatment into one potent and practicable form, by a remedy which has in *each* and *all* of these respects a direct bearing upon the morbid conditions—which will re-kindle the expiring taper—which will recover the pulse, the temperature, the colour of life—which will burn up the blood-poisons, and in so doing develop a true, natural reaction—which will restore to the eliminative organs the prime element of their functions:—if, Sir, we can do this, we need not fear the charge of dabbling in *specifics*, but be sure that we have brought to bear upon the exigencies of collapse one of Nature's mightiest agencies. You will already have anticipated that *oxygen* is the only principle which, on true physiological grounds, can lay any claim to this distinguished position.

Now, exact as is the adaptation of the physiological effects of oxygen to the remedial indications of collapse, the trials which have hitherto been made of it have not answered the sanguine hopes which its striking fitness inspired. This is freely admitted, but the explanation is obvious. Its administration has never been premised by those *mechanical* means which could *alone* render the blood eligible for its action; venous injections have never been recognised as the *necessary* preliminary to its exhibition; the mechanism of the respiratory function (which secures oxygenation by the transit of the blood-globules, floating in a medium which *never* exceeds a certain density, in *single series* through the pulmonary capillaries) has been quite forgotten, in presenting to the *tarry* blood of collapse an atmosphere of oxygen. As well might we expect a fish to live and swim in treacle, as the delicate oxygen-carriers—now collapsed by the loss of their contents, and crushed by the unnatural density of the surrounding medium—to perform their vital office under such circumstances. If we even deny to the blood corpuscles this function, the case remains the same; blood which is too thick to circulate can never be oxygenized with-

out first being mechanically diluted. This is the simple and true explanation of the failure of oxygen in those extreme cases, in which *alone* it seems to have been tried.

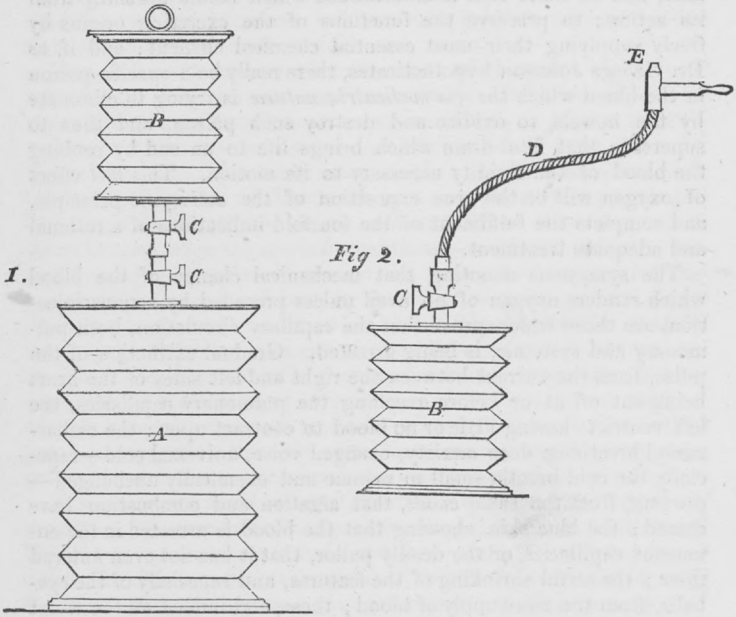
Oxygen may of course be administered without aqueous injections whilst collapse is merely impending, and before the symptoms which mark the mechanical disablement of the blood are developed. In all stages short of this, its effects will be to prevent the accumulation of combustibles in the circulation; to maintain the fluidity of the blood by its union with hydrogen; to sustain the pulse, the heat, and all those vital manifestations which result normally from its action; to preserve the functions of the excreting organs by freely supplying their most essential chemical element; and if, as Dr. George Johnson hypotheticates, there really be a specific poison in the blood which the *vis medicatrix naturæ* is trying to eliminate by the bowels, to oxidize and destroy such poison, and thus to supersede that fatal drain which brings life to an end by robbing the blood of the fluidity necessary to its motion. This last effect of oxygen will be the true exposition of the *astringent* principle, and complete the fulfilment of the fourfold indications of a rational and adequate treatment.

The symptoms denoting that mechanical change of the blood which renders oxygen of no avail unless preceded by venous injection, are those which prove that the capillary circulation, both pulmonary and systemic, is being arrested. Gradual extinction of the pulse, from the current between the right and left sides of the heart being cut off at or before reaching the pulmonary capillaries, the left ventricle having little or no blood to contract upon; the embarrassed breathing, deep anxiety, changed voice, universal cold—especially the cold breath, small in volume and chemically unchanged—proving, from the same cause, that aëration and combustion have ceased; the blue skin, showing that the blood is arrested in the cutaneous capillaries, or the deadly pallor, that it has not even entered them; the awful shrinking of the features, and especially of the eyeballs, from the non-supply of blood; these, and indeed all the worst symptoms of advanced Cholera, proclaim most emphatically, that the position of the life-stream is such as to call alike for the most potent mechanical and vital remedies we can employ; and such are aqueous injections* and oxygen.

If I have at all succeeded in pointing out the peculiar remedial adaptation of Nature's first element to the exigencies of her worst trial, and the circumstances which prevent or ensure its successful application, I have now the not less important task of showing how it may be made as promptly available as any other remedy; for

* As the good effects of saline injections are abundantly and satisfactorily explained on the simple principle of mechanical dilution, I have not thought it necessary to allude to the supposed influence of the salts they contain. My own belief is, that distilled water at 104° or 106° would answer, not only as well, but much better than these solutions, or even than perfect artificial serum.

after all, the idea of oxygen in Cholera will prove little better than a physiological abstraction, interesting, indeed, but barren, unless we can obtain it, and administer it too, as easily and as quickly as a chalk mixture or a calomel and opium pill. This practical desideratum I am happy to say I have been able to supply, by a very simple and portable apparatus, which, whilst furnishing an abundant magazine of gas, admits of its being mixed in any proportions desired with atmospheric air, and breathed, either pure or thus diluted, without the slightest difficulty. Thus *Fig.* 1 shows:—



A, The permanent reservoir, made of gas-proof material and holding about twenty-four gallons of pure oxygen. *B*, The inhaling bag, inverted and receiving oxygen from the reservoir, by the stop-cocks, *C C*, any number or the whole of its five compartments being thus filled, by lifting them up by the ring. To mix the oxygen with air, the inhaling bag, after receiving the proportion required of the gas, is unscrewed, placed on its bottom, and expanded to the full by lifting the upper compartments by the stop-cock, which when open admits the air.

Fig. 2.—The inhaling bag detached and ready for use; the flexible tube *D* terminating in the mouth-piece *E*, which has two valves, by one of which the oxygen is inspired, and by the other the expired air escapes into the atmosphere, without the necessity of removing the tube from the mouth.

To this simple and instantly available contrivance for the internal administration of oxygen, I have added means, equally simple and available, for its external or supplementary application, whereby the well-known respiratory powers of the skin may be brought into operation, and the large quantity of blood circulating in the cutaneous capillaries be subjected to the immediate action of the remedy, heated if thought necessary from the extent and severity of the collapse. Of the importance of this supplementary oxygenation, both in Cholera and many other complaints, where from morbid causes the blood cannot be brought sufficiently under the natural influence of the vital element, there can be no doubt; but as I hope shortly to make my newly-invented *pneumatic bath* the subject of another communication to the profession, it is unnecessary that I should do more at present than call attention to its practical connexion with the treatment in question.

The possibility of instantly obtaining such large quantities of the gas as might be required in a visitation of Cholera, may be doubted by those who have only seen this element generated in the class-room for chemical experiments, where the operation is conducted with almost as much caution as if the retort contained gunpowder. The fact is, that nothing is more easy, safe, simple, and cheap, than to produce, in a few minutes, hundreds of gallons of oxygen, provided the apparatus for so doing be properly constructed, and on this point as well as any other connected with this paper, I shall be happy to communicate to any of my professional brethren who may honour me with an application, all the information I possess.

As precautionary points, two things only need attention in treating Cholera by [illegible]n :—

1. To guar[illegible]t the production of more carbonic acid than can be got ri[illegible] lungs and skin. The unusual accumulation of the elements o[illegible]spiration in the blood renders this a matter of great danger, and if neglected, fatal coma might speedily ensue. We should, therefore, watch carefully against any symptoms of narcotism, and keep the skin freely exposed to the atmosphere, or even to a current of fresh air. The rapid generation of heat internally will render the patient quite independent of external temperature.

2. Excessive reaction, and the danger of congestive or inflammatory consequences, from the sudden restoration of the full tide of blood through recently (comparatively) bloodless structures. There is great risk of these complications in lungs which are predisposed to disease, or have already suffered from structural lesions. Careful watching, and especially of the pulmonary symptoms, can alone guard against these accidents, and when they do occur, prompt relief should be given by the usual means.

And now, Sir, in thanking you for your candid perusal of this communication, I rejoice to say, that it contains no pretensions

whatever original discovery, but, on the contrary, professes only to revive and combine facts and principles so generally known and so fully acknowledged as to be undoubted truisms. And for this reason I have not quoted authorities, for there is no work of recognised merit on Cholera which does not elucidate, more or less, that blood-pathology which calls for mechanical dilution by aqueous injections, and for the reactionary effects of oxygen—or, in shorter words, for water and fire—as the true and natural therapeutic instruments of a rational treatment. I leave in your hands the labour and glory of demonstrating by practical results, when the pestilence shall again visit us, the above truths, which science cannot question; and I hope to hear of their being made immediately available at the seat of war, where, I fear, the blood of many of our noble fellows which the sword may spare, may, as the autumn approaches, pass into this fearful condition.

I have the honour to remain

Your obedient Servant,

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