THE TREATMENT OF CHLORINE GAS POISONING.

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From the attacks on April 27 and 29, 1916, in front of Hulluch, I had the opportunity of treating a number of cases of acute poisoning by chlorine gas. These cases arrived fourteen hours after being gassed. The weather conditions were good, and the following is an account of the treatment adopted:

METHODS AND EFFECTS OF TREATMENT.

Slight Cases.—The routine treatment for slight cases was as follows:

1. Ammonia capsule.
2. Atropine ½ grain hypodermically, if not already administered.
3. Fluid diet or light diet for twenty-four hours.
4. Open air in a marquee during the day to ensure constant change of air.
5. An expectant mixture of ammonia carbonate on the second day.
6. Evacuation to base on third day if condition admits.

Serious Cases.—No routine treatment can be adopted for the severe cases because the nature of one case differs from that of another, and a different treatment has to be adopted. I divided these cases into two groups: the "pulmonary" and the "cardiac failures," because each of these groups demands a separate line of treatment.

Treatment of Pulmonary Cases.—By these I mean cases coming in deeply cyanosed, chests full of râles, in great distress, and dyspnœa. After the administration of ammonia and atropine, venesection was done to the amount of fifteen to twenty-five ounces. After forty-eight hours these cases were given light diet and an expectorant mixture of ammonia carbonate and detained in hospital to time of writing. These cases if venesected on admission do well. Oxygen to this class of case is beneficial and especially so if given in concentrated amounts through a rubber mouthpiece, a gas-bag and two-way valve. The mere administration of oxygen by means of a funnel held near the face is wasteful and of little good.
Cardiac Failure Cases.—A case admitted pallid instead of cyanosed, chest not bubbling with fluid, and a feeble pulse. These cases may be mistaken for lighter cases because there is no marked distress, but they are even more serious than the cyanotic type because they have a sudden collapse.

The following example illustrates the fact:

Pte. F., aged 28. Admitted April 30. On admission he was not distressed, not cyanosed, and was placed with the slighter cases. The next morning at 12 he collapsed suddenly, his pulse became feeble, and he died at 3.20 p.m., the same afternoon, in spite of stimulants.

Venesection does no good in these cases because the heart is not engorged, and there is no great increased resistance through the lungs. Stimulants to these cases are indicated, and strychnine, digitalin and pituitrin have been given with good results.

EFFECTS OF TREATMENT.

(1) *Ammonia capsules* stimulate respiration and in many cases lessen the cyanosis. The patients ask for them.

(2) *Atropine 1/60 grain.*—This is given as a routine, but I have had no definite proof that it has a good result. It certainly cannot have any appreciable effect upon the amount of fluid in the lungs, but it may tend to lessen bronchial spasm, because there have been no cases of the latter. In no case was any cardiac collapse brought about by its administration.

(3) *Venesection.*—The effect of venesection is, I think, striking. It has been done on forty-two recorded cases, all serious, of which twelve died, and thirty-two are still alive.

It seems to have the following effects:

(i) Relieves cyanosis greatly.

(ii) Relieves congestion in the lungs, enabling the patients to breathe more easily.

(iii) Relieves the acute headache which patients are subjected to after twenty-four hours of the gas poisoning.

(iv) Promotes sleep by the physical withdrawal of blood from the system, and a patient wakes refreshed and less distressed than before.

Early venesection is necessary, as is shown in the following example:

Ten cases were cyanosed and equally distressed. Five were venesected and did well with no further treatment. Of the remaining five two died within twelve hours and three became livid and
The Treatment of Chlorine Gas Poisoning

more distressed within twelve hours, and venesection was done then. These three required cardiac stimulants after bleeding. The longer the heart has to work against an increased peripheral resistance the weaker it becomes and, by bleeding early, the resistance is lowered and the heart is not put to so great a work.

The following are notes of the first thirty cases upon which venesection was tried:


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These are ten out of the first thirty upon whom venesection was done and all ten lived. Those who died were moribund on admission. All cases bled early, did well, but those bled later required cardiac stimulants. In all cases the respiration and pulse rates were lowered, the colour improved, and sleep was induced; and I began to rely on venesection as a routine for the cyanotic group of patients.

(4) Expectorants.—I tried ammonia carbonate and ipecacuanha separately. Twelve men put on ammonia carbonate had copious frothy sputum on the third day and the chests cleared up. If ammonia carbonate is given before the end of forty-eight hours too great irritation results.

Twelve men put on ipecacuanha, thirty minims of the vinum every two hours, had very little cough, very little sputum and that of a viscid nature, but their chests cleared up equally well. Ipecacuanha was not given in sufficient amounts to promote vomiting, but it seems to have absorbed moisture from the tissues, which have replaced it from that in the lungs, and thus dried up the lung condition equally well as when ammonia carbonate had been administered.

(5) Hypnotics.—Morphia was given in two different classes of cases:—

(a) For the pleuritic pain at the costal margin, caused by the emphysematous condition of the margin of the lung underneath. This begins on the third day and morphia is the only method of relief when applications of iodine, mustard leaves and fomentations have failed.

(b) To promote rest: the following is an instance:—

Pte. L., aged 21. Admitted very cyanosed and delirious. Very feeble pulse and chest very congested. No venesection was done on account of the pulse; twenty-four hours after admission he was worse, more cyanosed, delirious, and very restless. He was weakening with his restless movements. Morphia half grain was given, although every condition contra-indicated it. He slept twelve hours, became less cyanosed, quiet and pulse greatly improved. He has made steady progress since, i.e., four days later. In this case morphia undoubtedly saved his life, but except for specially selected cases, it is not a routine line of treatment.

(6) Postural Treatment.—This is of value in those cases whose condition is so severe that the reflex of coughing is abolished. If a patient is conscious, lying on his side with the lower end of the bed raised a foot encourages the secretion in his lungs to flow towards
the mouth, when it can then be expectorated. If a patient is unconscious, lying flat on his back with the foot of the bed raised two feet leads to the mechanical trickling down of the pulmonary secretion into the throat, when it can be swabbed out at regular intervals.

Example.—Lance-Cpl. C., aged 38. Admitted very cyanosed and distressed. Unconscious. His chest was congested. Had been bled at the field ambulance, but venesection was done again; twenty ounces were removed. His cyanosis improved, but his chest symptoms remained as coughing was abolished. Foot of bed raised two feet. Oxygen given under pressure and pituitrin. Although still unconscious, a great deal of fluid trickled into his mouth till he frothed. This fluid has been swabbed out at intervals (regularly), and now the patient is in a much better condition than on admission, although still unconscious.

(7) Emphysema.—Pulmonary emphysema leads to agonizing pains. These begin on the third day, as a rule, occurring where the lung is unprotected, i.e., along the edges of the lung at the costal margin, and causes great pain of a pleuritic nature over the lower ribs in front. Painting with strong iodine and morphia when it can be given in safety is effective.

Surgical emphysema was found in four cases, and usually requires no treatment, but the following case was exceptional:—

Cpl. D., aged 22. Admitted April 27. Very distressed and cyanosed. His chest was not so very congested as to account for the cyanosis, and his pulse was good. At the root of the neck in front he had a soft round diffuse swelling at each side, extending over his clavicles in front to a couple of inches over his pectoral muscles, and behind it extended to the trapezius muscle, and above to the angle of the jaw. Breath sounds could be heard over the swelling with a stethoscope. On palpation it felt soft, crepitant, and became tense at each inspiration, worse so on coughing. The cyanosis was caused by pressure from it on to the trachea. A large pad of wool was strapped tightly down on to the side of the neck and clavicles, enabling the patient to breathe and cough without increasing the pressure on the trachea. In twenty-four hours his colour improved, breathing was easier, and he has made a good recovery.

(8) Mouth Condition.—On the second day patients' mouths became covered with a very viscid, foul, and green mucous, causing much discomfort. Repeated swabbing with hydrogen peroxide clears this condition up in twenty-four hours, and carbolic and glycerine mouth-washes further improve it.
(9) Lactate of Soda.—On May 1 ten patients were selected of equally increased respirations, and equally serious, as far as could be judged. The five odd numbers were put on lactate of soda (fifty per cent), and the five even numbers were put on no treatment.

Respirations were counted at regular intervals:

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Lactate soda given—

1 p.m. 7 p.m. 2 p.m. 7 p.m. 10 a.m. 6 p.m.

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Post-mortem.—There was generally marked cyanosis. Rigor mortis was always well marked. There were no petechial hemorrhages. The venous system was engorged. With the exception of one case, there was no fluid in the pleural cavity. In this case there was a good deal of serous fluid in both pleural sacs. The lungs were smaller, and did not show either the extensive emphysema or the oedema noted in the cyanotic type of case.

The lungs were enlarged and very markedly emphysematous, especially at the margins. The heart was slightly enlarged, the left ventricle full of dark clot, the right ventricle less full, and the pulmonary artery contained a dark blood-clot in each case.

Death was due to acute congestion of the lungs and subsequent heart failure.