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The Revair Aerosphore in Curare Paralysis and Its Possible Service in Respiratory Embarrassment Due To Poliomyelitis

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The Revair Aerophore in Curare Paralysis and Its Possible Service in Respiratory Embarrassment Due to Poliomyelitis.*

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IN A PREVIOUS PUBLICATION[1] we set forth the beneficial possibilities of the Revair Aerophore in coping with the problem of respiratory embarrassment due to paralysis of the muscles of respiration. This second report presents the results of our findings in this investigation.

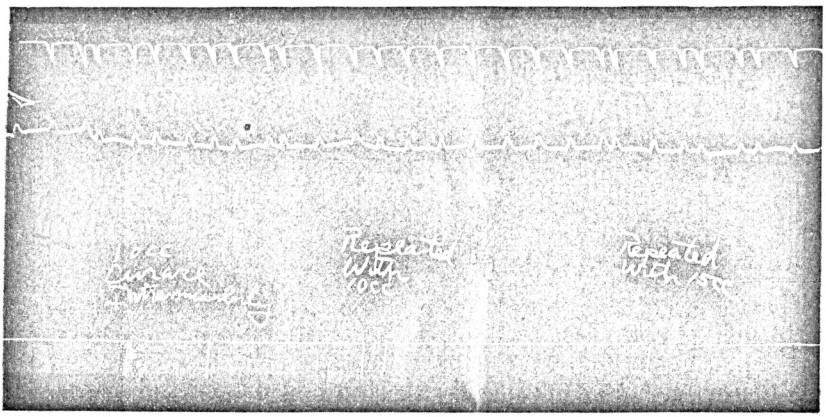
Three types of experiments were formulated. In the first the animal under pentothal anesthesia was surgically prepared, in the usual manner, for taking graphic records of the respiration and blood pressure by means of cannulae inserted into the trachea and one carotid artery. In the second, the intact animal was given a single fatal dose of curare intravenously, and upon cessation of respiration the Aerophore was applied through the mask. This mask was a metal cone, the distal end of which was covered with a rubber diaphragm containing an aperture for snug coaptation with the mouth and nose of the animal. In the third the trachea was cannulated under novocain anesthesia during the interval between injection and respiratory arrest.

An arrangement was made to connect the positive and negative tubes of the Aerophore to a Y tube, the single end of which was firmly inserted and fixed into the tracheal cannula. Here, as in the second group of cases, the Aerophore was operated upon the cessation of respiration. It was discontinued only when automatic respiration was certainly reestablished, and the animal was clearly out of danger from further embarrassment. Dogs were used in all cases.

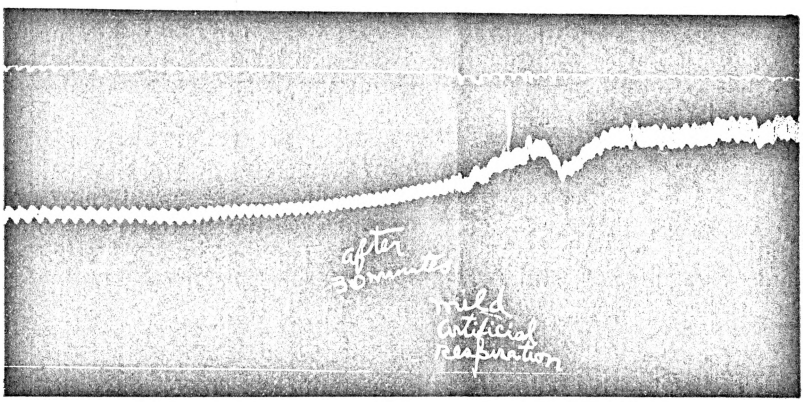
Experimental

FIRST. Directly following the cessation of respiration and the customary asphyxial rise of the blood pressure, artificial respiration was established by means of the Revair Aerophore. The records show the reestablishment of respiration during the course of its operation. In addition, changes in both the blood pressure and the cardiac cycle clearly reveal the beneficial oxygenating action of the Aerophore. Whenever the operation of the Aerophore was discontinued before automatic respiration was restored, the animal died. On the other hand, in spite of the degree of paralysis, the heart remained alive so long as the Aerophore which maintained the respiratory cycle was operated. The record here produced (fig. 1), was taken on a female dog, 8.4 kilograms in weight. This dog received subcutaneously a total dose of 4 grams of curare as a saturated aqueous solution in three injections of 10, 10 and 15 cubic centimeters respectively, spaced a few minutes apart. According to Jackson[2] 20 cubic centimeters is a large dose, regardless of the strength of the particular preparation. After 30 minutes, normal respiration ceased and artificial respiration by means of the Aerophore was begun. Functional activity of the heart and lungs was maintained

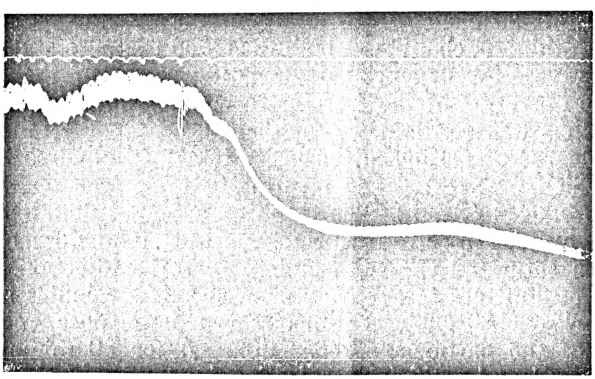
*From the Department of Pharmacology of Howard University, School of Medicine.



Normal Injection of Curare

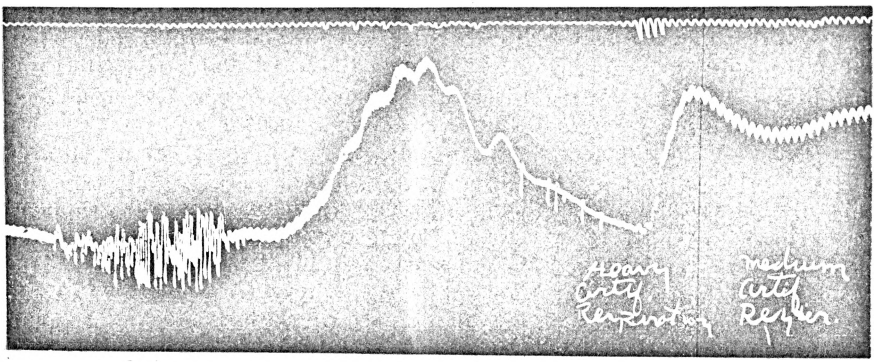


Effects of Curare Effects of Artificial Respiration

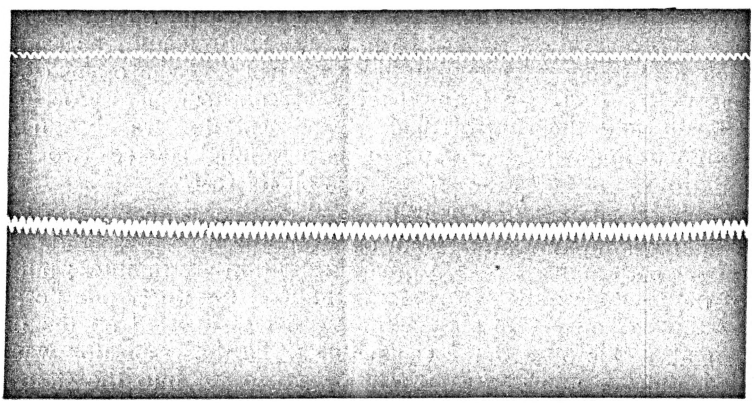


Effects of mild artificial respiration

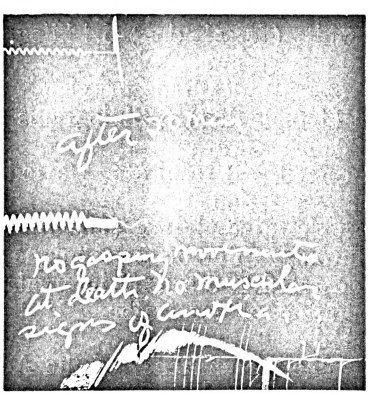
Figs. 1, 2 and 3



Vagal Beats after continuous mild artificial respiration



Continuous medium artificial respiration



The Terminal Event upon discontinuance of artificial respiration.

Figs. 4, 5 and 6

during the use of the Aerophore. After twenty minutes, artificial respiration was discontinued and death of both organs promptly followed. That the Aerophore was the only factor keeping the heart active is seen in the last graph (fig. 6), where there was no compensatory rise whatever when the Aerophore was cut off. (See graph records).

Second. To determine the strength of our preparation of curare, a 4 per cent solution of the drug was prepared. Forty milligrams of this solution, freshly prepared, was injected intravenously into the saphenous vein of the hind leg of a dog. In six minutes there was general immobility and relaxation of the anal and bladder sphincters. The respiration was gravely embarrassed, being reduced to a gasp five to six times per minute. After eighteen minutes of critical gasping, regular respiration was resumed without experimental interference and twenty-eight minutes after injection of curare the animal was on its feet, completely recovered.

Accepting this dose (40 mg.) as just bordering on the lethal dose we gave two male dogs twice this quantity (80 mg.) in the same way. One dog (8.9 kilograms) was used as control and the other (8.6 kilograms) was treated. In both instances respiratory arrest occurred in six minutes, and the control died. The respirator was begun on the other animal immediately. Automatic breathing started two minutes later, and in ten minutes the animal was on its feet.

One hundred and twenty milligrams of the same preparation was next employed. A typical protocol of results is here presented. In this experiment both animals ceased breathing within six minutes; but in the case of the treated animal, life was maintained for thirty minutes. During the shift of operators manual pressure was exerted on the neck of this animal. This opened the esophagus while the respirator was being operated, thereby allowing a current of air to get into the stomach instead of the trachea.

The protocol:

Brown and white (female dog) 6.4 kilograms	
Injection 120 mg. curare	11.06 a.m.
Respiration ceased—death occurred	11.12
Dark brown (female dog) 6.3 kilograms	
Injection 120 mg. curare	11.09
Respiration ceased and respirator started	11.15
Spontaneous respiration	11.23
Stopped Aerophore respirator (air in stomach through an error in technique)	11.30
Respirator operated at 5 second intervals	11.33
Stopped operation of respirator	11.35
Death occurred	12.00

Third. To determine the efficiency of the Aerophore (barring such an accident as the one mentioned in 2) we have cannulated the trachea and directly intubated it with the Aerophore. In all cases, even with doses as high as 200 milligrams of curare, recovery occurred when the Revair Aerophore was employed.

A typical protocol is here produced:

Treated: Female dog—8.6 kilograms

2.49 120 mg. curare
2.51 Respiration arrested
2.52 Aerophore respirator employed
2.54 Automatic breathing started
3.11 Natural breathing
3.15 Respirator synchronized with breathing
3.34 Animal recovered and on foot.

Note: Animal alive and well after one week.

Discussion

CURARE PARALYZES at the myoneural endplate of the motor somatic system, while poliomyelitis destroys the motor nuclei of the antero-lateral horn cells within the cord. Functionally considered, the end points are similar, differences being principally the degree of involvement and correction. Curare paralysis is non-selective, and hence it is likely to be more extensive and diffuse than the paralysis of poliomyelitis, involving all the skeletal musculature. The degree of involvement depends upon dosage in the first instance, and massiveness of the infectious process in the other. The chief differential, however, refers to the problem of correction. Within limits, curare paralysis is a reversible process, while the paralysis resulting from poliomyelitis is incurable, since the cell bodies once destroyed are not capable of regeneration. In this condition correction through exercise and re-education has to take the place of a cure. It is precisely at this point that the employment of the Aerophore may be used to good advantage. By means of the gentle application of atmospheric pressure, both negative and positive, this apparatus promotes (or restores) respiration and aids in the elimination of curare from the system. The same mechanism would be expected to induce warmth and improve the circulation to the affected respiratory musculature in conditions of poliomyelitis affecting the phrenic nerve and/or intercostal nerves and the muscles of respiration innervated by them.

Summary

FIRST. Paralysis of the motor somatic musculature by curare, functionally similar to the paralysis encountered in poliomyelitis, is amenable to treatment with the Aerophore respirator.

2. Convincing experimental evidence is presented.

3. The Revair Aerophore aids in the cure of curare paralysis; therefore we infer that it should prove beneficial in the re-education and improvement of the function of muscles whose direct nerve innervations have been impaired or destroyed by poliomyelitis.

References

1. Maloney, A. H.: Artificial Respiration and the Revair Aerophore. *Current Researches in Anesthesia and Analgesia*, 23:1, 39 (Jan.-Feb.) 1944.
2. Jackson, D. E.: *Exper. Pharm. and Mat. Med.*, 2nd Ed. p. 271.