

## LIFE WITHOUT BREATHING OXYGEN—II

BY INDERJIT SINGH, AMARJIT SINGH AND KUNWARJIT SINGH

*(From the Department of Physiology, Medical College, Agra)*

Received January 16, 1961

INTRAVENOUS injection of oxygen in dogs and human beings at body temperature has been given by various observers. The amount that can be thus introduced is very small, about 25 per cent. of the total requirements in dogs and 5–6 per cent. in human beings. There are however two methods by which it has been found possible to supply all the oxygen requirements of dogs by the intravenous route. Singh (1935) found that the amount of oxygen that could be injected intravenously was increased if the atmospheric pressure, under which the experiment was performed, could be raised; he was able to keep a dog alive without breathing oxygen through the lungs for 16 minutes by injecting oxygen intravenously under 4 atmospheres of air pressure. The second method is to lower the oxygen consumption by hypothermia to such an extent that it equals the amount of oxygen that can be injected intravenously, the animal being under ordinary atmospheric pressure (Singh, 1960); this was done by lowering the body temperature of dogs to 20–20°C. In further experiments (Singh, Singh and Singh, 1960), it was found that the best temperature for intravenous injection of oxygen was 25–27° C.; in the present research, therefore, an attempt has been made to keep dogs alive without breathing oxygen at 25–27° C.

### METHODS

The chief difficulty in these experiments is the increased oxygen consumption due to shivering. This has to be prevented by injection of tubocurarine. Seven unselected mongrel dogs, varying in weight from 15 to 20 kg. were used. A preliminary injection of atropine sulphate, gr. 1/100, was given subcutaneously. Basal narcosis was induced by intraperitoneal injection of 30 mg./kg. pentobarbitone, to reduce shivering; anaesthesia may be deepened, as such a procedure diminishes shivering. When the dogs came under the anaesthetic, a tracheal cannula was inserted and artificial respiration started with an Ideal respiration pump, which was connected to a Benedict-Roth apparatus to measure the oxygen consumption. An injection of tubocurarine (15–30 mg.) was then given intravenously. The body temperature was reduced at the rate of 1° C. in 10 minutes by surface cooling with ice to 25–27° C.

Oxygen was injected from a cylinder by means of a side tube connected with a cannula. The cannula was attached to a burette filled with normal saline and was tied to a small vein of the foot. The injection was made by two 50 c.c. Record syringes which filled and emptied alternately. Electrocardiograms were recorded frequently to know the condition of the heart.

The begin with, the spirometer tracings rise at an angle which is proportional to the oxygen consumption. The dog may be considered not breathing oxygen from the exterior if during intravenous injection of oxygen these tracings become horizontal, the heart beating normally as shown by the electrocardiogram.

#### RESULTS

The results are shown in Table I. It was possible to keep all the 7 dogs alive without breathing oxygen from 15 to 25 minutes (Fig. 1).

TABLE I

*Intravenous injection of oxygen in dogs at 26° C. rectal temperature*

Number of experiment	Weight of dog, kg.	Oxygen consumption at 26° C., c.c. per min.	Intravenous injection of oxygen, c.c. per min.	Total oxygen injected, c.c.	Minutes kept alive without breathing oxygen
1	18	41	40	1000	25
2	16	32	30	600	20
3	16	40	40	600	15
4	20	52	50	1000	20
5	17	42	40	800	20
6	18	50	50	1000	20
7	16	30	30	600	20

#### DISCUSSION

Intravenous injection of oxygen at 25–27° C. has been found to be the most convenient and easy method to demonstrate life without breathing oxygen through the lungs in dogs. All the oxygen required by the animal

can be supplied by the intravenous route so that they need not breathe oxygen from outside.

#### SUMMARY

If the body temperature of dogs is reduced to 25–27° C., it is possible to give all the oxygen required by the animal by the intravenous route so that they need not breathe oxygen from outside.

#### REFERENCES

1. Singh, I. .. *J. Physiol.*, 1935, 84, 315.
2. ————— .. *Arch. Int. Pharmac. Therap.*, 1960, 129, 239.
3. ———, Singh, A. and .. *Proc. Ind. Acad. Sci.*, 1960, 52, 66.  
Singh, K.

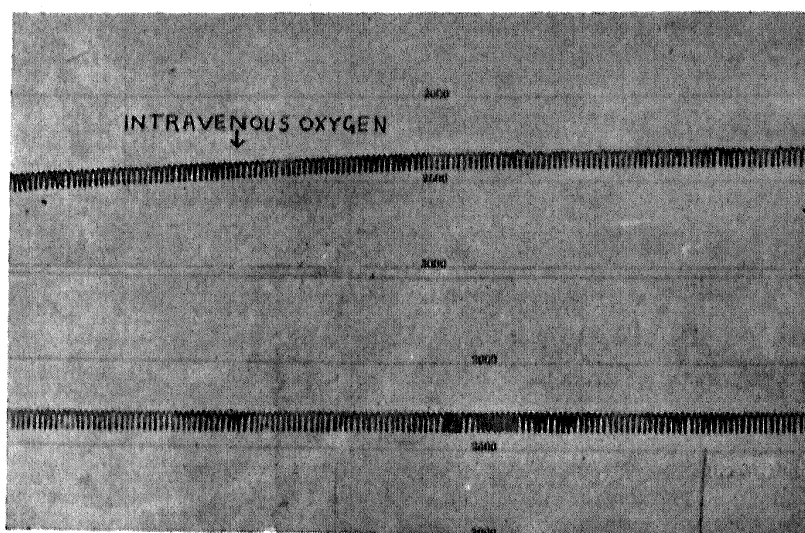


FIG. 1. Intravenous injection of oxygen in dog at rectal temperature  $26^{\circ}\text{C}$ . Respiratory tracings. At arrow mark oxygen injected at the rate of 40 c.c. per min. The tracings become horizontal after about 2 min. This lag is due to the dead space between the Benedict-Roth apparatus and the dog. Lower tracing continuation of the upper. Weight of dog, 17 kg.; oxygen consumption, 42 c.c. per min.