Improved Device for CO₂ Absorption in the One-Man Bag for High Altitude Pulmonary Oedema

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The 'One-Man HAPO Bag' is a simple apparatus that consists of a bag large enough to accommodate a lying patient. The bag is made from either rubberized fabric (DEBEL bag, India) or other synthetic fabric material (Gamow bag, USA) and can be pressurized by a foot pump. The Indian DEBEL bag has two additional features that are not available in the Gamow bag.

The first is an automatic pressurizing device. This detects pressure below 100 mmHg inside the bag and automatically activates a battery-operated compressor that can bring up the pressure to 130 mmHg. The second feature is a soda lime-containing canister that is screwed on to a facemask that the patient has to wear before entering the bag. Thus the patient, while inside the bag, breathes through the facemask and carbon dioxide in exhaled air is absorbed by soda lime. The intention is admirable but the disadvantage is that the patient's face is partially covered by the facemask and canister assembly. This not only hampers visual assessment of the patient by the attendant outside the bag but also hampers vocal communication by the patient.

I have devised a very simple method of overcoming this problem at a low cost. I connected a small fan (used in computers for cooling) of diameter 4 cm to one end of a rubber sleeve. The other end of the rubber sleeve was connected to the soda lime containing canister. The fan was rated for 12V DC but was operated off a 9V DC battery. This device was placed inside the bag near the head-end. As the fan operated it

expelled air from one end of the sleeve thus drawing in air through the canister at the other end of the sleeve. The battery lasted for more than six hours at a stretch. Thus, a continuous flow of air was maintained through the canister and carbon dioxide was evidently absorbed from within the bag. Fig. 1 shows a schematic diagram of the apparatus.

The efficacy of this device was established during a trial. In this trial, samples of air were collected in vaseline-coated glass syringes every 10 minutes while inside the bag. These air samples were analysed for carbon dioxide content (Fig. 2) with a blood gas analyzer (ABL 300, Radiometer, Copenhagen). The carbon dioxide accumulation was not greater than when the facemask and canister arrangement was used. The trial had to be terminated at 45 minutes when not using any carbon dioxide absorbing canister due to respiratory discomfort possibly as a result of carbon dioxide accumulation.

This design has been submitted to DEBEL, Bangalore, for further refinement and development of a compact rugged unit. It has been suggested to them

Fig. 1 : Schematic diagram of improved device for absorbing CO₂ in the one-man recompression bag for HAPO

Fig. 2 : Carbon dioxide concentration in one-man bag

that the efficiency of the fan could be further improved to increase rate of circulation and therefore more CO₂ will be absorbed. The vanes of the fan could be protected from damage by placing it recessed. Arrangements could also be made to hold spare 9V batteries within the unit itself. It is quite likely that a 12V compact dry battery source would have resulted

in higher fan RPM and airflow. However, such batteries are not available commercially and it would be better to use the freely available 9V DC battery.

It is felt that this device is a viable and advantageous alternative to the existing system and the major plus point is that the patient's face remains free and yet carbon dioxide absorption can be continued.