THE ADVANTAGES OF GLOSSOPHARYNGEAL BREATHING

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The advantages of glossopharyngeal breathing (G.P.B.), or "frog breathing," are widely known in the U.S.A. from the writings of Dail *et al.* (1955), and have recently been reported by Kelleher and Parida (1957).

A year ago one of our patients was taught G.P.B. after he had been in the respiratory unit for 10 months. The improvement in his general and psychological condition has been so striking that we thought it might be of interest to readers elsewhere.

The patient, a youth of 18, is totally paralysed from the neck down as a result of anterior poliomyelitis. Before he learned the technique he was pale-faced, thin, despondent, and limited to spending his days in a tank respirator, with a few minutes each day on a rocking bed. After mastering G.P.B. he could go home for six-hour periods, visit the cinema, travel by car many miles over the countryside at altitudes of nearly 7,000 ft. (2,130 m.), visit his friends, and lead a reasonably full social life. He is now a plump, sunburnt, healthy youngster who has learned to live with his physical handicap, though there has been no change in the degree of paralysis.

Mechanism of Frog Breathing

Frog breathing is a mode of breathing used by people with respiratory paralysis and sometimes by normal people to augment their vital capacity in underwater swimming (Dail *et al.*, 1955). The tongue is the main organ of breathing. It is thought that the following steps constitute G.P.B. (Zumwalt *et al.*, 1956). The lips are opened, the floor of the mouth is depressed, the palate elevated to close the nasopharynx, the larynx closed, and the oesophageal orifice shut. This enables a maximum amount of air to be accommodated in the buccal cavity. The lips are then closed: a small amount of air is lost during this manœuvre, and the air is trapped. The tongue is then pushed upwards and backwards, forcing the air into the pharynx. At this moment the larynx is opened and the air passes into the trachea, where it is trapped by closure of the larynx. This is the mechanism of each "stroke." About ten strokes are taken for each breath, and at the end of this breath the larynx is opened and the air expelled passively.

Each stroke takes in approximately 60 ml. of air, each breath being about 600 ml. There are, of course, individual variations in frequency and stroke volume, though it is thought that the volume of each stroke should be at least 1% of the expected vital capacity. Some patients use, in addition, a sucking mechanism to get air into the mouth and pharynx. This is especially so when the nose is used to frog-breathe while the mouth is kept closed. The detailed technique for teaching G.P.B. can be found in the *Manual of Instruction* published by the National Foundation for Infantile Paralysis.

The advantages of G.P.B. may be divided into two main groups: physical and psychological.

Physical Advantages

The various advantages of frog breathing have been described fully by Dail *et al.* (1955) and by Zumwalt *et al.* (1956). Briefly, G.P.B. improves the vital capacity, which in these severely paralysed patients equals the inspiratory capacity; the coughing power is augmented, as evidenced by an increase in the maximum expiratory flow rate (M.E.F.); G.P.B. is a useful method, possibly the only effective method of chest stretching (Plum, 1957); physiotherapy, such as hydrotherapy and the use of tilt boards, is made more feasible, and, of course, long periods can be spent without any form of respiratory aid.

G.P.B. cannot be taught in the presence of paralytic involvement of the tongue and pharyngeal muscles or concurrent disease of the heart or lungs. The patient must have a desire to learn or much effort will be wasted. It can be learnt even if a tracheotomy tube has been inserted: the tube must be corked tightly, as the pressure developed in the trachea may blow the cork out.

There are a few theoretical disadvantages to G.P.B. Air inhaled through the mouth is dry and irritating. This can be overcome by pulling in air through the nose. Our patient has mastered this technique. It may take a long time to learn, and after the method is learnt it may take weeks before any appreciable "breathing" time is acquired. Our patient took three weeks to learn, and it was two months before he could breathe two hours, but in a further two months this was increased to six hours. Although drinking is possible during G.P.B., eating should not be attempted in case a choking attack occurs, which may render the patient helpless. Theoretically, the increased intrathoracic pressure may interfere with the venous filling of the right side of the heart (Dail *et al.*, 1955), but we have noticed no alteration in pulse rate or blood pressure in our patient. This interference with venous filling is more likely to apply during maximum G.P.B., which, in any case, is carried out only a few times daily.

During the 10-months period of observation our patient's vital capacity remained at 200 ml. His G.P.B. vital capacity is now 2,700 ml. and his M.E.F. 109 litres a minute.

To illustrate the usefulness of the cough-augmenting power of G.P.B., our patient, while out for a ride, partially occluded his right bronchus with a plug of mucus. On his hurried return he was put in a tank, and with the help of maximum G.P.B. and positive pressure in the tank he was soon able to cough up the offending plug.

Chest Stretching.—Before being taught to frog-breathe, our patient could spend only about five minutes on a rocking bed because of insufficient ventilation. He was rocked in the position of maximum efficiency, the rock being from the horizontal to the head-up position, the angle of the rock being about 40 degrees. By means of an inflatable belt applied to the abdomen below the umbilicus and timed to inflate as the head was reaching the horizontal, sufficient ventilation was obtained. This was the position until he learned to frog-breathe. After this he was able to spend several hours on the bed without other aid. His ventilation was adequate. This was calculated by means of the Radford nomogram and measured on a Benedict–Roth spirometer, using a nose-clip and a mouthpiece. The patient was instructed not to frog-breathe—this could be detected by observing the spirogram. We feel that the explanation of this increased ventilation was due to the fact that G.P.B. had stretched his lungs, so improving their compliance, though no actual measurements of compliance were made.

Psychological Advantages

Perhaps the most striking improvement in this patient was the change in his psychological outlook. The fear of dying from asphyxiation must constantly loom large upon the horizon of patients whose respiratory muscles are

paralysed. This is always in evidence if mechanical failures of respiratory apparatus develop or if the power fails. It can also be seen when using positive pressure through a face-mask when the tank has to be opened for the first time, and when weaning from respiratory aids is started. By learning frog breathing it might be said that the patient has taught himself to live and is no longer beset by fears of dying. After the initial psychological improvement due to removal of these fears further improvement develops through the sense of achievement from learning the technique and in acquiring further breathing-time. Other factors are the sense of freedom from respiratory aids and the ability to lead a fairly full social life. It is possible that some of the psychological improvement in our patient could be put down to the eventual acceptance of his position, but we feel that the dramatic coincidence with the ability to frog-breathe is against this.

Chronic respiratory cripples confined to an institution live a far more circumscribed life than can be imagined by normal people. They have little interest beyond the four walls of their ward and at times show a remarkable ability to be petty and "take it out" of their attendants. Jealousies of attention given to other patients become a prominent feature of their reaction to their environment. This hostility reaction is, of course, not uncommon in many disabling diseases. It is of greatest importance to enlarge the small unchanging scene before them. In patients "fixed" to a ward, social interests are confined to daily visits by friends and relatives, to routine talks, to cinema shows, and to occupational therapy. However, the main drawback to this existence is that they themselves are static, and it must be obvious to them that their own interests are due to artificial stimuli, dependent upon others. On the other hand, a patient who is independent of fixed respiratory aids becomes able to enjoy an ever-changing source of stimulation from outings in a wheelchair, car rides, etc. He now feels that although he is physically unable to move he is no longer utterly dependent upon the visitations of others to obtain the stimuli necessary for normal expression.

Before learning G.P.B. our patient had frequent fits of depression with episodes of weeping several times a day. He was difficult to amuse, because his interests flitted from one thing to another. He had evidence of withdrawal, and as a rule did not encourage visitors other than his close family circle. He was thin, ate indifferently, and always had pains here and there. Since mastering the technique the weeping fits are a thing of the past. He spends considerable time reading, typing with a mouth-stick, and playing chess, and doing jigsaw puzzles, also with a mouth-stick. He is much less hostile and does not try to put "a spanner in the works," except very occasionally. He is now pleased to see any visitors who might wish to see him. He eats well, rarely complains, and is plump and sunburnt.

G.P.B. has so many advantages that we believe that the teaching of this technique is one of the most important advances made in the treatment of respiratory poliomyelitis in recent years.

Summary

A description of the mechanism of glossopharyngeal breathing is given. The disadvantages are briefly outlined and a description of some of the physical and psychological advantages is given.

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SPIROGRAPHIC STUDIES IN GLOSSOPHARYNGEAL BREATHING

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Glossopharyngeal breathing (G.P.B.) has been used in the U.S.A. and in Scandinavia as a substitute for the normal respiratory mechanism in patients with gross paralysis of the respiratory muscles and to augment the remaining ventilatory ability. It may also be used to improve the compliance of the lungs and chest and to aid the coughing power.

This investigation was carried out to estimate the speed of air flow during expiration, which is important in coughing; to estimate the effect of different positions on the efficacy of the method; and to attempt to elucidate the peculiar characteristic features of the spirographic pattern.

The subject of these tests was an 18-year-old European male who had complete paralysis of all spinal muscles except those of his neck and the right upper rectus abdominis. He had been taught to use G.P.B. after he had been paralysed for nine months. The tests were performed over a period of 10 months, beginning some six weeks after he had learned G.P.B.

During the period of observation there was no improvement in the degree of paralysis, the vital capacity remaining at 200 ml. throughout this time.

Methods

Spirographs were obtained, using (1) the Sandborn metabulator or a Benedict–Roth spirometer at slow speeds, and (2) a high-speed kymograph (20 cm. in 10 seconds) with a spirometer similar to that described by Bernstein *et al.* (1952). Recordings were made in the semi-sitting and in the supine position both during spontaneous respiration and during G.P.B.

During the tests the patient held the mouthpiece between his teeth, the nose being clipped. The spirometers were filled with a mixture of approximately 50% air and 50% oxygen.

All the results are at ambient pressure and temperature, and saturated. The average atmospheric pressure was 625 mm. Hg and the temperature 23–25° C.

Measurements were made of the minute-volume, the vital capacity, the number of strokes per breath, the number of breaths per minute, and the speed of each stroke. The

Results

	Spontaneous Respiration	Glossopharyngeal Breathing
Vital capacity	200 ml.	Supine, 2,464 ml. Semi-sitting, 2,016 ml.
Maximum expiratory flow	Over 100 ml.—15 l./min.	Over 1 litre: (a) Normal G.P.B., 86 l./min. (b) Maximum G.P.R. effort: Sitting, 109 l./min. Supine, 85·7 ,,
Stroke volume		60 ml. approx.
,, duration		Variable: 0·40–0·55 sec.
No. of strokes per breath		10–12
Respiratory rate	24/min.	6–8/min.
Tidal volume	200 ml.	600–660 ml. (Sandborn metabulator)
Minute-volume	4,800 ,,	4,800–5,200 ml. (Sandborn metabulator)

All volumes are at ambient temperature and pressure saturated.