There is no evidence that any danger may arise from the use of hypnosis in medical treatment.

There is no special "gift" required to induce hypnosis.

The general practitioner is particularly well suited to use hypnosis as a method of treatment, as he is usually familiar with the patient's background and has his confidence, which is important for successful hypnotherapy.

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FLUCTUATION OF ARTERIAL BLOOD PRESSURE IN ASTHMA

BY

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If the arterial pressure is measured by the ordinary auscultatory method during an attack of bronchial asthma, a few beats, usually two or three, will be heard at a higher level of pressure than the others. If the cuff pressure is kept at this level for several respiratory cycles, it will be noticed that these two or three beats of higher pressure occur at the beginning of each expiration. Usually the cuff pressure has to be lowered 20–30 mm. Hg before the point is reached where all the beats are heard. These fluctuations in the systolic pressure in bronchial asthma have been studied by Gauchat and Katz (1924), Katz and Gauchat (1924), Tinel and Jacquelin (1931), Rackemann (1931), Osgood (1943), Osgood and Ehret (1943). The following is a further study.

Material

The material comprises 33 patients (19 women and 14 men) with bronchial asthma. The diagnosis was clinically certain in all cases. Patients with other concurrent disease, or in whom severe emphysema or cor pulmonale had developed, were excluded. The mean age of the women was 47.8 years, and of the men 41.7 years.

On the basis of the severity of the clinical symptoms the cases were divided into three groups: (1) *Mild bronchial asthma*:—Only a few sibilant rales in the lungs; subjectively, no real dyspnoea; physical activity unrestricted. (2) *Moderately severe bronchial asthma*:—Sibilant rales throughout both lungs; subjectively, definite although not severe dyspnoea; auxiliary respiratory muscles not much used; hard exercise impossible. (3) *Severe bronchial asthma (involving primarily an attack or status asthmaticus)*:—Wheezing heard without a stethoscope; numerous sibilant rales and noises; dyspnoea so severe that the patient had to sit upright or lean forward to secure maximum use of the accessory muscles of respiration; patient hardly able to move.

The fluctuations in arterial pressure were measured by the ordinary auscultatory method with a mercury sphygmomanometer. As the changes in systolic pressure proved much easier to detect than those in the diastolic it was decided to observe only the former in this part of the study. Measurement was effected by finding, in the usual

way, the maximum pressure at which the first beats began to be heard. As noted above, the one to three beats coinciding with the beginning of the expiration were heard, especially in cases of severe asthma, at a considerably higher pressure than the other beats. These few higher beats are easily overlooked unless each even-number pressure-reading near the maximum is observed long enough—for not less than two complete respiratory cycles. Subsequently the cuff pressure was lowered by 5 mm. Hg at a time until all the beats could be heard continuously irrespective of the phase of respiration; the difference in pressure between the few higher beats and this pressure was recorded. The lowest beats (two or three) were found at the end of expiration and/or at the beginning of inspiration. During the most severe attacks of asthma, however, it was sometimes impossible to obtain a reading at which all the beats could be heard continuously during the whole respiratory cycle: before the lowest beats at the end of expiration were heard the ones at the beginning of expiration had vanished. In these few cases the systolic pressures at the beginning and end of expiration were measured separately. However, this was much more inaccurate than the method of measuring described above.

Results

As can be seen from Table I, the fluctuation in systolic blood pressure due to respiration increased with the severity of the bronchial asthma. In cases where the fluctuations were

TABLE I.—*Fluctuation of Systolic Blood Pressure Due to Respiration in Patients with Bronchial Asthma, Measured With a Mercury Sphygmomanometer*

Severity of Bronchial Asthma	No. of Cases	Fluctuation of Systolic Blood Pressure Due to Respiration (mm. Hg)
Mild	19	4±0.6
Moderately severe ..	9	13±1.5
Severe	5	25±1.7

recorded while the asthmatic symptoms were being relieved by adrenaline, there was a clear correlation between the range of pressure fluctuation and the severity of the symptoms. In three patients with severe bronchial asthma the fluctuation in systolic pressure was 25 (E. V.), 20 (A. N.), and 20 mm. Hg (L. E.). The corresponding pressure readings after the relief of symptoms by adrenaline were: E. V., 15 mm. Hg (symptoms still moderately severe); A. N., 5 mm. Hg (symptoms mild); L. E., 5 mm. Hg (symptoms nearly subsided). In two moderately severe cases of bronchial asthma the fluctuation in systolic pressure was 10 mm. Hg. After adrenaline had produced a nearly complete disappearance of the asthmatic symptoms none of the cases showed any demonstrable pressure fluctuation.

To investigate further the connexion between these fluctuations in arterial pressure and the degree of respiratory obstruction present, clinically healthy persons were asked to breathe through glass tubes of various diameters. The ratio of the resistance to respiration produced in this way (taken as corresponding to that during an attack of bronchial asthma) to arterial pressure was studied.

To start with, the *intra-arterial pressure* of the femoral artery of the test subject was followed during "tube respiration." The pressure was recorded by Sandborn's electro-manometer. All the tubes through which respiration took place were 10 cm. long. The largest diameter was 10 mm.; the tubes then successively narrowed in diameter (see Table II). During respiration the nose was pinched and the tube, fitted with a special mouthpiece, was held between the lips. The results are shown in Table II, which gives only the variation occurring in the course of single respiratory cycles, as pressure recordings obtained over a longer period were not considered fully comparable; for when an ordinary sharp syringe needle is being used to record intra-arterial pressure a change in its position in relation to the arterial walls may affect the results.

TABLE II.—Continuous Recording of Intra-arterial Pressure of Femoral Artery of Healthy Man Aged 30 During Respiration Through Tubes of Different Diameters. Blood Pressure Before Test, Measured by Mercury Sphygmomanometer, was 115/75 mm. Hg. The Maximum and Minimum Values are Given in Parentheses

Tube No.	Diameter	Fluctuation of Systolic Blood Pressure Due to Respiration (mm. Hg). Mean of Three Respirations	Fluctuation of Diastolic Blood Pressure Due to Respiration (mm. Hg). Mean of Three Respirations
1	10 mm.	5 (3-7)	4 (2-5)
2	8 "	8 (5-11)	6 (5-8)
3	6 "	13 (12-14)	10 (5-15)
4	4 "	47 (35-54)	33 (24-38)
5	2.5 "	78 (73-85)	59 (58-60)

As Table II shows, fluctuation due to respiration occurs in systolic, diastolic, and pulse pressure, and the fluctuations increase as the diameter of the tube used for respiration diminishes. The systolic pressure varied most. The lowest pressures were recorded at the end of expiration and at the moment of changing to inspiration. The highest values coincided with the beginning of expiration. The Chart illustrates samples of the pressure curves. They show, for example, that the three pulse waves coinciding with the beginning of expiration had the highest systolic pressure. The phenomenon was particularly clear when the narrow tubes were used. The pulse pressure, highest at the beginning of expiration, was sometimes reduced to nearly zero with tubes 4 and 5.

The fluctuations in arterial pressure due to respiration through the tubes were recorded also by mercury sphygmomanometer, as in cases of asthma. Only the fluctuation in systolic pressure was recorded, as this had proved much easier to detect than the diastolic in the asthmatic cases and because the intra-arterial measurements had shown that the changes in the systolic pressure were the larger. When tubes 4 and 5 were used, no pressure reading could usually be obtained at which all the beats could be heard continuously irrespective of the phase of respiration. The reason for this phenomenon—the same as that sometimes observed in severe bronchial asthma—is clear from the pres-

sure curves shown in the Chart. With tubes 4 and 5 the systolic pressure dropped at the end of expiration below the diastolic pressure recorded at the beginning of expiration. (In some cases the pulse pressure even dropped to zero at the end of expiration.) In these cases the systolic pressures at the beginning and the end of expiration were, if possible, measured separately as described. The results are given in Table III, which shows that the fluctuation of the systolic pressure increased with the resistance of respiration.

TABLE III.—Effect of Respiration Through Tubes of Different Diameter on Fluctuation of Systolic Blood Pressure as Measured with a Mercury Sphygmomanometer. The Six Test Subjects Employed, Aged 15 to 50, Were Clinically Healthy. They were Requested to Breathe as Calmly as Possible, Without any Forcing

	Difference in mm. Hg between Maximum Systolic Pressure Value at Beginning of Expiration and Minimum Systolic Pressure Value at End of Expiration. Mean Values. Maximum and Minimum Values are Given in Parentheses
No obstruction in airways	0 (0-0)
Tube 1 (10 mm.) ..	0 (0-0)
" 2 (8 ") ..	4 (10-0)
" 3 (6 ") ..	17 (35-5)
" 4 (4 ") ..	30 (50-15)
" 5 (2.5 ") ..	40 (60-25)

Discussion

The results obtained in bronchial asthma for fluctuations of systolic blood pressure due to respiration corresponded closely to those reported by Osgood (1943). The method evolved in the present investigation to determine this fluctuation was also fairly similar to that used by Osgood. As I was not aware of Osgood's investigations until my own study was completed, this similarity deserves special emphasis.

Measurements of arterial pressure during respiration through tubes of varying calibre showed clearly the close correlation between the severity of obstruction to the respiratory tract and the degree of fluctuation in arterial pressure

Fluctuation of arterial blood pressure due to respiration. Recording by intra-arterial method. Samples of the pressure curves.—Top: Respiration through tube 5 (length 10 cm., diameter 2.5 mm.). Middle: Respiration through tube 4 (length 10 cm., diameter 4 mm.). Bottom: Respiration through tube 3 (length 10 cm., diameter 6 mm.). (E.C.G. changes apparently correspond to changes in the electrical axis.)

due to respiration. In practice, the degree of obstruction to the respiratory tract can be assessed from the fluctuation in arterial pressure in both asthma and other conditions. Although the intra-arterial pressure is a more accurate guide in such cases, its measurement even to-day places such a strain on the patient that I regard the corresponding fluctuation in systolic pressure easily obtainable with an ordinary sphygmomanometer, as adequate for practical purposes.

Although the severity of bronchial asthma can usually be readily assessed from the other clinical symptoms, the determination of this fluctuation in blood pressure may assist in the assessment; in addition, it may provide a clearer picture than the other symptoms of the extent of the respiratory obstruction. It also gives an idea of the extent, so important in bronchial asthma, of fluctuations in intrathoracic pressure during respiration. Fluctuation in arterial pressure due to respiration is considered to be closely correlated with the corresponding fluctuation in intrathoracic pressure. In strong expiration, increased intrathoracic pressure results in the blood from the lung-bed travelling at increased speed into the left side of the heart and from there into the systemic circulation. With the start of expiratory strain a transient rise in systolic and diastolic pressure is observable. If the venous return to the heart is obstructed, however, this is followed immediately by a reduction in the stroke volume of the heart and also by a drop in the systolic and diastolic pressures (Judson *et al.*, 1955; Jones *et al.*, 1956). The negative intrathoracic pressure associated with inspiration again increases the venous return to the heart, and as a result the systolic discharge of the left ventricle begins again to increase.

TABLE IV.—Effect of Respiration Through Tubes of Different Diameters on Fluctuation of Intra-oesophageal and Systolic Blood Pressure. Four Series of Measurements on the Same Clinically Healthy Test Subject Aged 38

	Difference, in mm. Hg, Between Rise of Intra-oesophageal Pressure Due to Expiration and Pressure Drop in Connexion with Inspiration. Maximum Values Obtained in Different Measurements	Fluctuation of Systolic Blood Pressure in mm. Hg. Maximum Values Obtained in Different Measurements
No obstruction in airways	0-5	0-0
Tube 1 (10 mm.)	0-10	0-5
" 2 (8 ")	10-15	5-10
" 3 (6 ")	10-20	35-45
" 4 (4 ")	30-40	40-50
" 5 (2.5 ")	30-50	55-60

Table IV gives an idea of the correlation between the fluctuations in the systolic blood pressure and the intrathoracic pressure when the respiratory tract is obstructed (respiration through the tubes). Observation of the intrathoracic pressure was effected by measuring the intra-oesophageal pressure. These pressures have been found to correspond closely. Intra-oesophageal pressures were obtained by means of a balloon (4 ml. capacity) on a 100-cm. length of polyethylene tubing (3 mm. in diameter) passed through the nose and into the oesophagus to a distance of 40 mm. from the nose. The system was air-filled, and the pressure was measured by a torsionmanometer.

In severe bronchial asthma even, the variations in systolic blood pressure were not nearly so extensive as the greatest noted on respiration through the tubes. This is attributed to the fact that in bronchial asthma a rise in intrathoracic pressure, while it forces air out of the alveoli, also constricts the bronchioli. There is, however, a certain limit above which the intrathoracic pressure interferes with expiration (Wyss, 1955).

Summary

The fluctuation in systolic blood pressure during respiration was studied in 33 patients with bronchial asthma by means of an ordinary mercury sphygmomano-

meter. In mild bronchial asthma the systolic blood pressure fluctuated by 4 ± 0.6 mm. Hg; in moderately severe asthma by 13 ± 1.5 mm. Hg; and during an asthmatic attack by 25 ± 1.7 mm. Hg. If the symptoms of bronchial asthma were relieved by adrenaline, the fluctuation in systolic blood pressure was reduced correspondingly.

The correlation between the degree of respiratory obstruction and the fluctuation of arterial pressure during respiration was studied. Test subjects breathed through tubes of fixed length but different diameter. The arterial pressure was recorded in six by a mercury sphygmomanometer and in one by intra-arterial measurement. In addition, changes in intrathoracic pressure were observed by measuring the intra-oesophageal pressure. It was found that the greater the obstruction to the respiratory tract the more extensive were the fluctuations in the arterial pressure. The same applied to intrathoracic pressure. The maximum arterial pressure readings were obtained at the beginning of expiration, during one to three beats, the lowest values (two to three beats) at the end of expiration. The systolic pressure fluctuated more than the diastolic. The maximum fluctuation recorded in a single subject, when breathing through the narrowest tube, was 78 mm. Hg by the intra-arterial method and 60 mm. Hg by mercury sphygmomanometer. The corresponding maximum fluctuation in the systolic blood pressure of six healthy persons aged 15-50 years, obtained by mercury sphygmomanometer, was 40 mm. Hg.

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The National Coal Board has published a report entitled "The Coal Industry in the U.S.S.R." The report is based on the observations of a technical mission which visited the U.S.S.R. in 1956, and includes a section on health and welfare. In the U.S.S.R. considerable importance is attached to industrial health services, especially in heavy industry; in 1956 24,000 doctors were stated to be employed as industrial medical officers. In 1955 some 1,300 were allocated to coal-mining. Hospitals and polyclinics in mining areas serve the whole population there. Large collieries had "health points" at the surface, and sometimes underground first-aid rooms. Each colliery visited had its own ambulance; and a strikingly high proportion of women doctors was noticed. All new entrants to the industry are medically examined; subsequently surface workers are examined yearly, and underground workers twice yearly. Efforts are made to screen the chest of all coal-miners annually, about 70-80% being so examined. In 1955, it was stated, 1.6% of underground workers were certified as suffering from silicosis (roughly equivalent to pneumoconiosis in British terminology). The Ministry of Health runs a large number of sanatoria, some of which specialize in the treatment of silicosis. Admission is granted according to both the medical need and the work record of the miner in question; an outstanding mining record entitles the patient to free treatment. The report is obtainable from the National Coal Board, Hobart House, Grosvenor Place, London, S.W.1; price 8s., post free.