# RHINO-SPHYGMO-MANOMETRY AN AID IN PHYSICAL DIAGNOSIS

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The act of breathing and the function of respiration are not synonymous terms. The latter includes all the processes which are involved with bringing oxygen to every cell in the body and with ridding the tissues and the organs of carbon dioxide after aerobic cellular metabolism has been completed. The former, the act of breathing, is essentially the bringing of air into the alveolar cells through the upper and lower airways with sufficient pressure, moisture, warmth and cleanliness to ensure optimal conditions for oxygen uptake, and for the elimination, in the reverse process, of carbon dioxide brought to the alveoli by the blood stream. In respiration and breathing the nose has many functions which are important supplements to the roles played by the heart, blood, lungs and other systemic organs.

The nose in the human is in many ways unique anatomically and physiologically. It has an external pyramid which maintains constant contact with the outside world by means of the air breathed. In good health man normally in non-strenuous pursuits uses his nasal apertures in inhalation and exhalation, the whole breathing cycle being under an automatic unconscious control. The nasal apertures consist not only of the nostrils, but also the vestibular structures and the valves leading into the nasal pyramid at the ostia interna. These structures together with the turbinates and the septum combine to provide the regulating mechanism for efficient quiet nasal breathing. Man usually uses his mouth when he becomes conscious of difficulty in breathing such as after working or exerting himself excessively, under many conditions of stress and strain, and especially when cardiac, pulmonary, or other illness hampers the supplying of oxygen to his tissues.

## Functions of the nose

The well known functions of the nose are the sense of smell and the warming, moistening and cleansing of air before it enters into the lungs. There are other less well known, but equally important, functions which the nose subserves and which have much clinical significance and in general are equally non-expendable. A few will be mentioned.

The creation of pressure differences between the lungs and the external apertures which assure the flow of the air streams. (1)

The regulation of body heat chiefly by influencing the moisture and heat of expired air. (2)

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The shifting of the main air stream from one nasal chamber to the other. This is brought about by the rhythmic cyclic alternation of the size of the turbinates both in the upright and reclining positions of the head. (3, 4)
The directing of the air stream towards the olfactory cleft and middle meatus. This assures a longer stay of air in the nose and passage over a greater surface of blood vessels, mucus blanket, sensory and autonomic nerves, and also a nearness to the olfactory mucosa. (5)
The constant stimulation of the trigeminus and other cranial nerve connections in the nasal mucosa by the air currents engender many reflex responses which altogether help the patient feel somatically oriented (if we may use such a term), at least help give him a feeling of well being; e.g., of "feeling good" after taking a deep breath through the nose.
The regulation of the direction and velocity of the air streams and their whirls and eddies. This assures among other things that the areas where the air streams will impinge and deposit the dust particles they are transporting are the ones best equipped and accustomed for this function. (6)
The nose in sleep responds to fatigue stresses which initiate movement of the head from one side to the other, which in turn inaugurates a major movement and turning of the body. This complete body moving cycle beginning in the nose and then involving the head and body insures a person's obtaining the maximum amount of rest during sleep, paradoxical as it may seem.
The regulation and creation of inspiratory resistance is accomplished chiefly by the turbinates in wide noses and by the nasal valve in narrow ones. (7) This resistance is a paramount requisite for the maintenance and stimulation of the elasticity of the lungs, a functional characteristic vitally connected with efficient lung and heart function. Nasal obstruction is intimately associated with lung compliance deficiencies, even when the nose is not being used for breathing. This relation has been adequately measured. (8) Resistance to expired air is physiologically essential and is enhanced by the contraction of the tracheo-bronchial tree and the closure of vocal cords during normal exhalation in addition to the "resistors" in the nose which are the turbinates, ventricles, and other vestibule structures.
It has long been known the olfactory sense has been integrated into the whole life process of an individual through the rhinencephalon, a primitive portion of the brain which is still highly developed and deeply involved with all bodily structures and functions. But the fifth nerve with its extensive distribution throughout the nasal mucosa receiving touch and often painful impulses with every breath has also very profound and intimate connections with many parts of the brain and spinal cord. (9) Its deeper nuclei in the mesencephalon together with the sensory and motor nuclei in the pons and the nuclei in the spinal tract (of the fifth nerve) are intimately connected with the nuclei and fibers of practically all the other cranial nerves, and at least the first four cervical nuclei and nerves. (10) These deep connections are intimate and very ramifying and thus it is not too difficult to visualize a contact between the nose and practically all the important structures supplied by the cranial and cervical nerves. Reflexes and referred phenomena between the nose and ears, the nose and the throat and larynx, the nose and the heart, lungs (11) and diaphragm, and even between the nose and abdominal contents are well established.

The intimate association of the nose and the psyche has justifiably often been emphasized. (12)
With all this in mind the **functional** examination of the nasal septum, the external nasal pyramid, the internal nose and the correlation of their functions with the homeostasis of other organs, near and distant, becomes a very vital problem and should be added to the usual inspection of nasal structures in the routine of doing general physical examinations.
During the last one hundred years a considerable amount of fundamental functional investigation (13, 14, 15) has been concentrated in these areas and for the past ten years a very active research program is in progress in many parts of the world. But much still remains to be accomplished to make objective testing of nasal functions a facile task.

**Objective tests**

While many nasal activities and characteristics have been described, no objective tests for any one of the numerous nasal functions is yet in wide usage, and with a few notable exceptions, correlation of nasal dysfunction with disease in other parts of the body has been inadequately explored. This was pointed out in a recent paper on research in rhinologic problems (16) which especially emphasized a few significant clinical problems that require urgent attention; namely, naso-pulmonary interdependence, the relation of nasal obstruction to hypoxia, the interrelation of nasal blood flow and temperature and skin temperatures and their response to atmospheric and other external changes and the determination of the work of breathing.

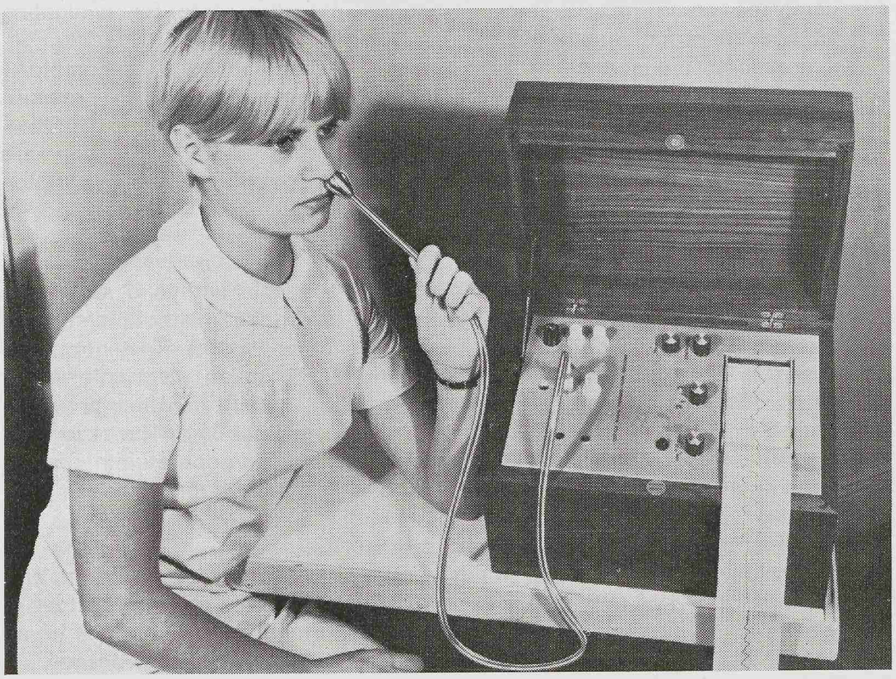

Figure 1. Rhino-sphygmo-manometry. Measuring pressure in **right** nasal chamber.

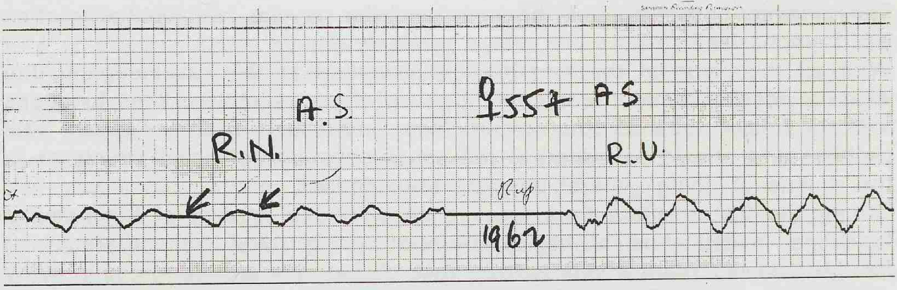


Figure 2. With head resting on left side, pressure in right nasal chamber (R.U.) is greater than when head is upright (R.N.). Arrows point to mid-cycle rest (see Figure 20). Large squares — horizontal — are seconds; vertical ones represent 10 mm. of water pressure. A.S. = after shrinking (soft tissues).

It is almost a decade (17) since the work of breathing through the nose was electronically measured and found to be normally greater than breathing through the mouth. This fact deserves to be taken most seriously in the treatment of cardiac and pulmonary ailments since such work is frequently increased fifty and more times by some nasal obstructions as well as by lower airway embarrassments.

In a search for objective tests of nasal function which would be easily applicable and available for everyday use we have investigated various methods of measuring nasal breathing pressures. (18) These give important diagnostic information which added to cardio-pulmonary determination and (breathing) gas analyses could provide more adequate objective data for evaluating normal and abnormal respiration.

Nasal pressures are studied in three ways: (1) Rhino-sphygmo-manometry - simple breathing pressures. (2) Rhino-revma-sphygmo-manometry - pressure changes created by forcing given flows of air in or out of the nose. (3) Flow-pressure relationship - pressures produced during normal breathing are recorded together with the actual rate of flow variations during inspiration and expiration.

**Method of rhino-sphygmo-manometry**

To perform a simple breathing pressure test, a nozzle with a 5 millimeter diameter is placed gently, but firmly, against one nostril without distorting or displacing the neighboring tissues of the other nostril. The nozzle is connected to a transducer, an amplyfier and finally to an electronic writer (Figure 1). The latter is calibrated to record 10 millimeters of water pressure for every 5 millimeters of deviation from the zero or base line. The recording paper moves at the rate of 5 millimeters per second. The apparatus in contact with one nostril is measuring the breathing pressures of the opposite side of the nose.

The nasal pressure tests are performed in several ways:

1. Each side of the nose is studied with the patient sitting upright and breathing quietly. The test is performed before and after a decongestant is topically applied. This test gives diagnostic information in over 80% of all patients in whom pressure tests will reveal a deviation from the normal.
2. The head is held to one side as in sleep and the uppermost nasal chamber

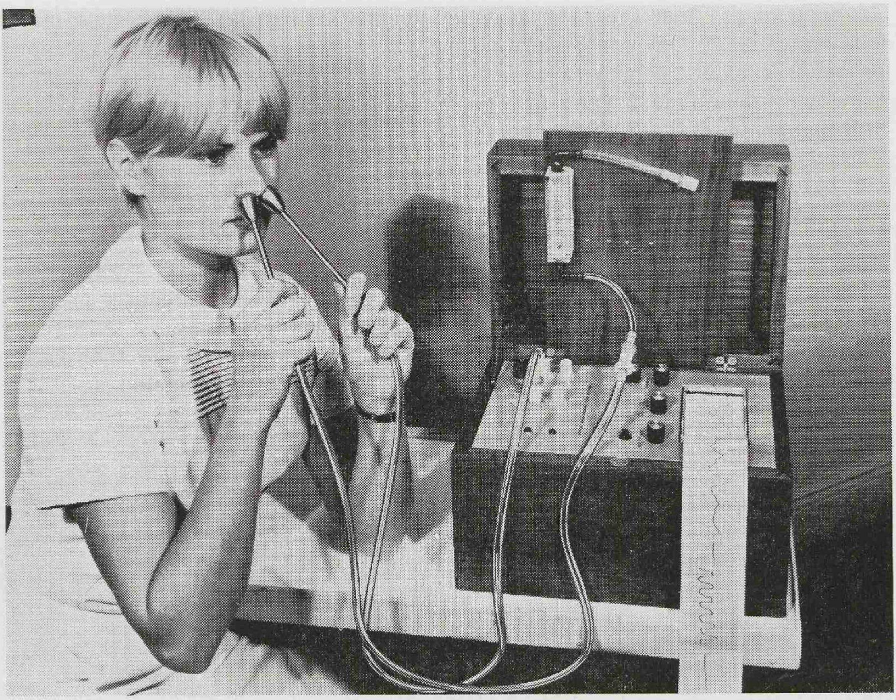

Figure 3. Rhino-revma-sphygmo-manometry. Measuring pressure produced in right side of nose when a given flow of air is blown or aspirated through a nozzle (right) of 5 mm. diameter.

is tested. This is done only after the nasal tissues have been shrunk. The recording reveals the effect of the natural falling in of the tissues about the nasal valve and vestibule. Pressure is usually increased (Figure 2) and, since breathing through the uppermost nostril is normal, the increase in the work of breathing during sleep can be evaluated and appreciated.

3. The pressures of breathing are noted after some physical effort. A standard procedure is to have the examinee stand behind a chair and holding on to the top of the back of it, he hops lightly from one foot to the other twenty times. In the event that one side of the nose has been found to produce increased pressure by previous tests, this nasal chamber is measured both before and after the other one.

4. Tests # 1 and # 2 are often repeated with the patient lying supine.

### Method of nasal revma-sphygmo-manometry

The pressures of breathing within the nasal chambers vary according to the rate of flow of the air passing into or out of them. Pressures will also change with the caliber of the apparatus conduits through which the air flows in these examinations. The apparatus used is selected so that a flow of air through it and through a normal nose can occur at a rate of 8 liters per minute while the resistance which develops is less than 100 millimeters of water pressure. (All tubings, nozzles, and connections have a bore of 5 millimeters.)

To execute the test the examinee exhales or inhales through a flow meter (rotometer) at 2, 4, 6, and 8 liters per minute, visually controlled. The resulting pressure created is picked up at the other nasal aperture in the manner previously described (Figure 3). The flow producing each pressure is written onto the graph at the time the recording is made (Figures 4 and 5). A deviation from the normal is often noted in many of those disturbed noses which do not reveal rhino-sphygmo-manometric changes.

**Method of determining nasal flow-pressure relationship**

This test is performed with the person sitting reposed, and breathing as quietly and normally as possible. A nozzle of 8 millimeters diameter is inserted gently into the nostril of the side of the nose being tested. It leads to a pneumotachograph and thence to a differential transducer and then on to the amplyfier and recorder (Figure 6). The calibration is adjusted so that a flow rate of 10 liters per minute is recorded as a deviation of 5 millimeters

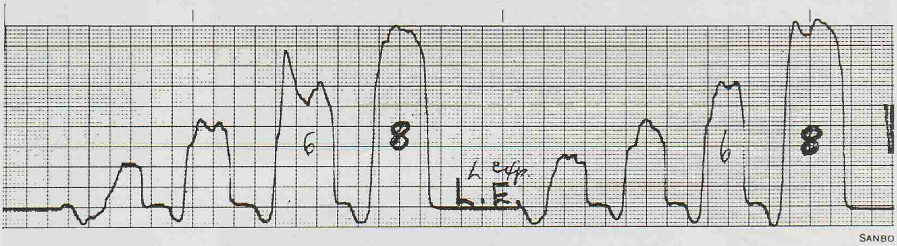


Figure 4. Pressures produced on exhaling through nose and apparatus (Figure 3) 2, 4, 6, 8 liters of air per minute. Normal pressure for 8 liters in 100 mm. of water or less.

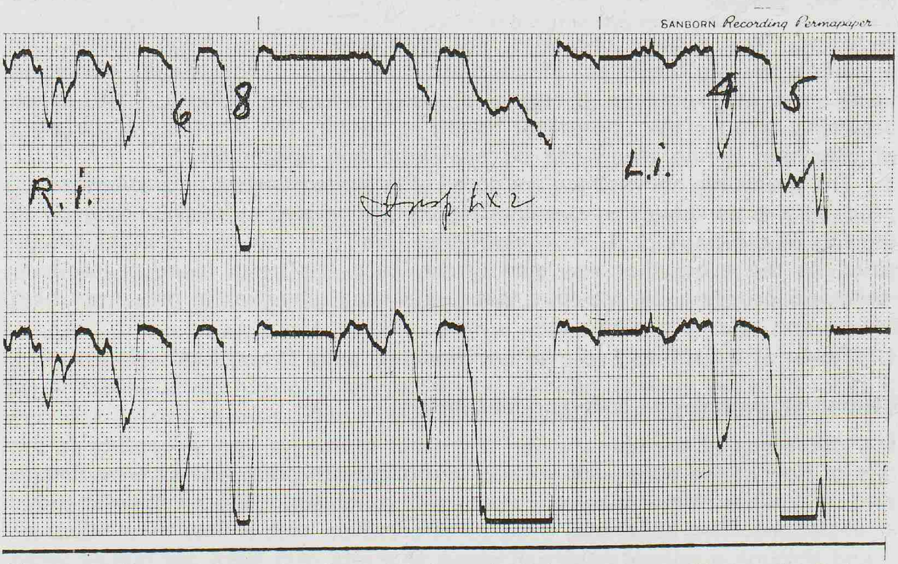


Figure 5. Pressures produced on inhaling through rotometer (Figure 3). Right is normal (R.I.) 8 liters per minute with pressure of 100 mm. of water. Left (L.I.) reduced to 5 liters per minute.


Figure 6. Measuring air flow with pneumatachograph. 8 mm. nozzle is in right vestibule. Nozzle in left is for measuring the concomitant pressure.

from the zero (or base) line. At the same time the pressure of breathing is picked up via the other nostril and recorded as described under rhino-sphygmo-manometry.

Flow and pressure can be recorded synchronously on a two-channel writer or simultaneously (which, in fact, is synchronous) on two separate recorders appropriately calibrated. But if only a single channel apparatus is available that is yet able to record flow as well as pressure, the tests can be performed consecutively. If the calibrations are set as suggested the data obtained are clinically just about as useful as when obtained from the more elaborate two-channel apparatus, or from the use of two machines.

The apparatus selected produces a normal average inspiration pressure of 20 millimeters of water and permits a flow of air of 20 or more liters per minute. This relationship is expressed as Flow over Pressure and the numbers produce a quotient of one ($\frac{20}{20}$) or more ($\frac{24}{18}$). When the pressure (or resistance) is higher, the work is harder and the flow is normally correspondingly increased; e.g., $\frac{\text{38 liters per minute}}{\text{35 millimeters of water}}$. With a disturbing nasal obstruction posterior to the nozzle measuring the flow of air, the pressure is usually much elevated while the flow diminishes, often markedly; e.g., $\frac{\text{10 liters per minute}}{\text{50 millimeters of water}}$ (Figures 7, 8 and 9).

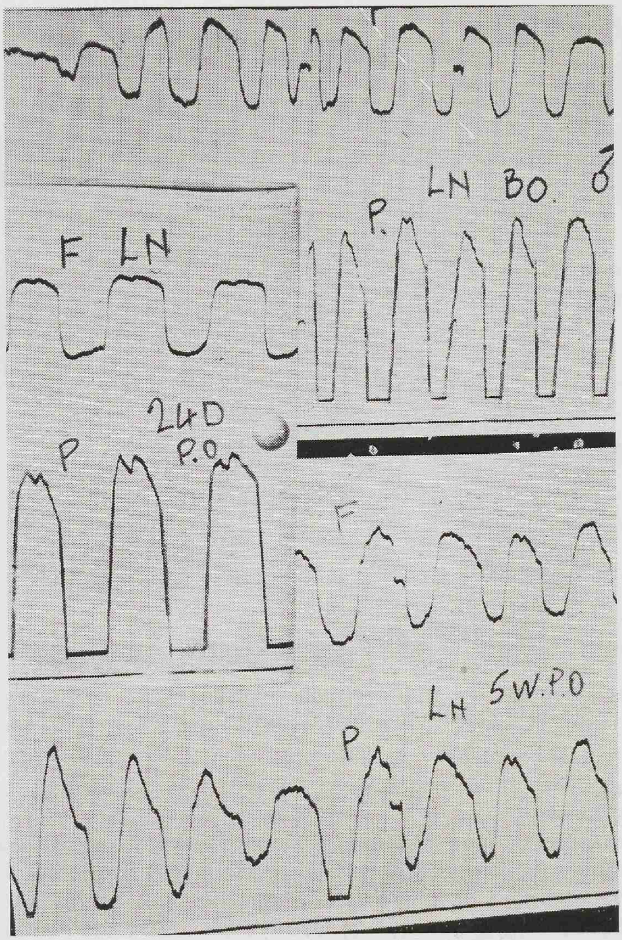


Figure 7. Flow (F) in liters per minute and pressure (P) in millimeters of water recorded on the left side (L.N.) before operation (B.O.), 24 D. after operation (P.O.), and 5 W.P.O. The flow-graph normally should be equal in extent to the pressure graph, or greater. The apparatus is calibrated to record 10 liters per minute for each large square up or down. A flow of 20 liters per minute or more occurs with a pressure of 20 mm. of water or less and is an average normal finding. Expressed as the ratio, $\frac{\text{flow}}{\text{pressure}}$, the numbers should be $\frac{20}{20}$ or another fraction giving a value of one or more.

Because one uses the same technic in testing both sides, each nasal chamber may serve as a control for the other which constitutes an invaluable asset in the recognition and evaluation of unilateral involvements.

**Discussion of rhino-sphygmo-manometry**

From a study of more than 10,000 recordings of tests performed on more than 3,000 patients in the manner described, we have obtained the following data.

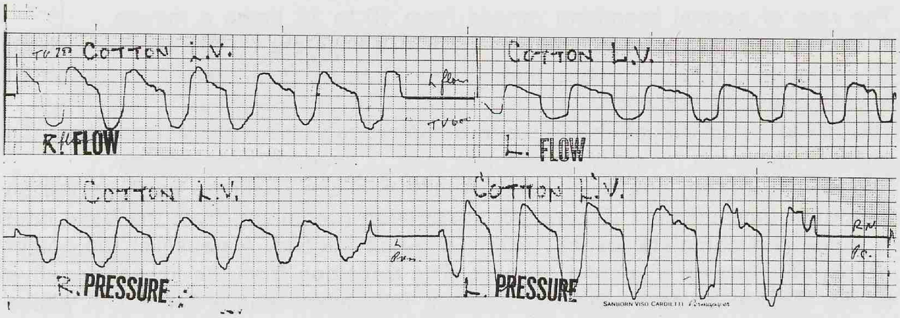


Figure 8. Normal flow-pressure relation seen on right side of the nose. To repeat — each square above or below the base line represents 10 liters per minute of flow and pressure of 10 mm. of water. An obstruction placed in the left nose decreases flow and increases pressure.

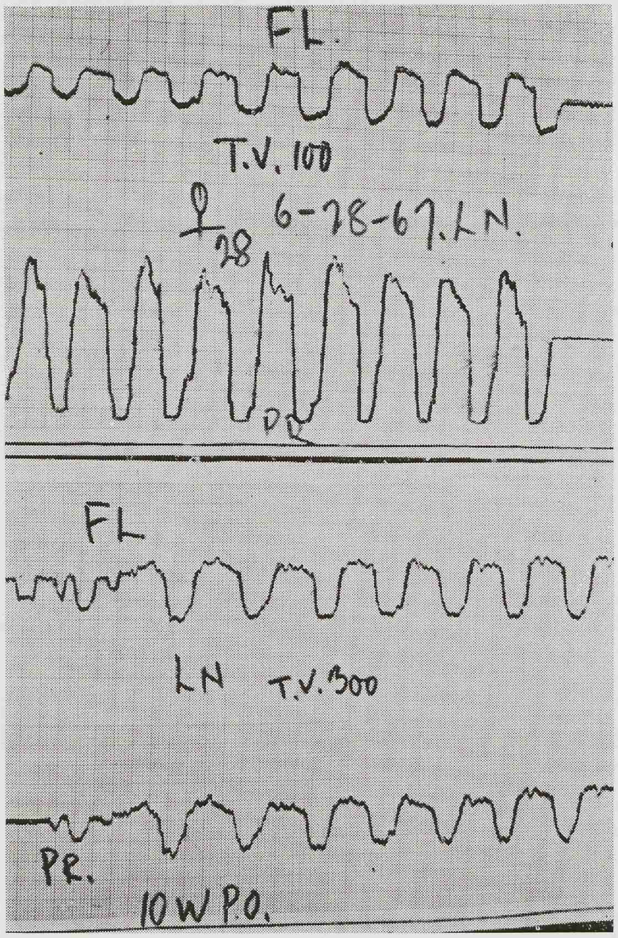


Figure 9. Upper graph reveals diminished flow before operation. Lower one shows normal ratio 10 weeks P.O. The tidal volume has increased from 100 ml. to 300 ml.

The rate of normal breathing ranges from 10 to 18 times a minute.

The pressure of a normal single breath at the height of inspiration is about 10 millimeters of water, while that of expiration is usually slightly less (about 8 millimeters of water).

The duration of negative pressure (inspiration) is normally less than the positive pressure, roughly 2 seconds and 3 seconds respectively.

The normal breath can be divided usually into five divisions each having an important time element (Figure 10). **Inspiration** (beginning from the base line) is quick and complete, usually within one-half second. A **pause** at the height of inspiration lasts a second or more. The **transition** from the lowest negative to the highest positive pressure takes a little more than a second. A **pause** at the height of expiration usually is longer than one second followed by a gradual **descent** to the base (zero pressure) line which consumes about 2 seconds. The pauses at the height of inspiration and expiration could possibly correspond to the occurrence of the Hering-Breuer reflexes and provide the optimal pressure circumstances for the diffusion movements of oxygen and carbon dioxide between the air cells of the lungs and the blood stream. Very marked blockage of a nasal passage produced by structural obstructions such as septal deviations and polyps, or inflammatory or allergic congestions may make it difficult to obtain a recording of the breathing pressure through the nose. But in most severe instances some recording can yet be made.

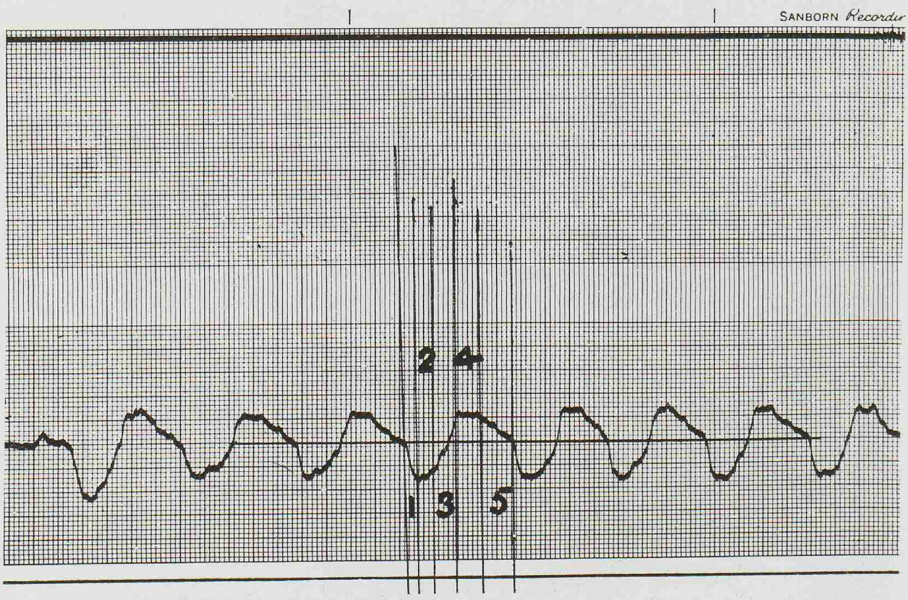


Figure 10. The parts of an average single breath. (Note that the rate is 15 breaths per minute of 4 seconds duration.) # 1. Time of reaching maximum inspiration beginning at zero pressure level. # 2. Duration of maximum inspiratory pressure (Hering-Breuer reflex?). # 3. Going from the "depth" of inspiration to the "heighth" of expiration. # 4. Duration of maximum expiration time (Hering-Breuer reflex?). # 5. Resolution and return to base line of no pressure.

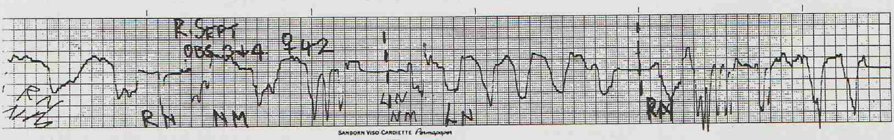


Figure 11. Irregular breathing pattern, right side only. (N.M. = no medication used for decongesting nasal mucosa.)

## Aberrations

There are five major aberrations of pressure curves which have been clearly delineated.

Group I — **Irregularities** of breathing pattern rhythms, amplitudes, frequency, and reversals of the ratios of pressures and time during inspiration and expiration are frequently noted and usually denote local derangements within the nose (Figure 11).

Group II — Marked **increase** in breathing pressure practically always means a nasal obstruction and is especially predominant if the stenosis is in the area of the nasal valves (Figures 12, 13 and 14). Elevations of pressure mean increase in the work of breathing. Work (W) is proportional to the pressure (P) multiplied by the rate of breathing (R). The product of these two factors is called the work coefficient (WoC).

The work of breathing, or more precisely the work of inspiration per minute, can be calculated by multiplying the work coefficient (pressure of inspiration times rate of breathing per minute) by the tidal volume. The latter is determined by employing spirometers. Small mechanical ones such as the Wright spirometer serve quite adequately for office examinations.

From a study of pressure graphs another factor can be calculated. After the first breath is taken the next four recorded breaths are examined. The

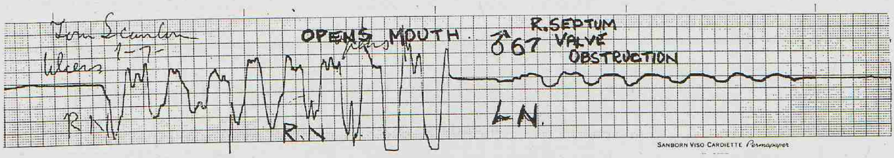


Figure 12. Obstruction of right valve area. Left nasal chamber (L.N.) open.

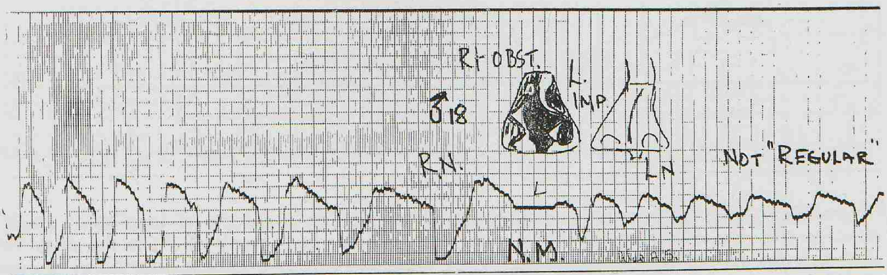


Figure 13. Right obstruction behind valve. Left recording becoming irregular and uneven in the presence of left septal impaction.

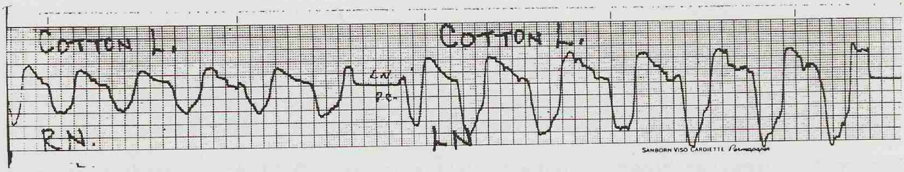


Figure 14. Cotton placed in left nose produces increase in pressure. Both right and left pressures were similar without the cotton implacement.

average of the inspiration pressures is multiplied by the time consumed in taking these four breaths. The product is referred to as the four breath factor (4BF). It is really only a number and describes no function or quality. However, it should be integrally similar to the work coefficient. When these numbers are far apart a disturbance of nasal function can be assumed (Figure 15).

Increase in the work of breathing may be the cause of tiredness and extreme fatigue especially after slight exertion. In patients with nasal obstruction it also occurs during sleep and makes such strained breathing a matter of great concern. Patients with this pathology usually respond favorably and promptly to surgical correction, a fact which can be corroborated by the pressure tests (Figure 16).

Some complexly obstructed noses with polyps, hypertrophic mucosae, and deviations in the areas of the middle turbinates have much clinical benefit from surgical treatment, but pressure testing may reveal that an apparently small deviation in the valve area and otherwise disregarded or discounted

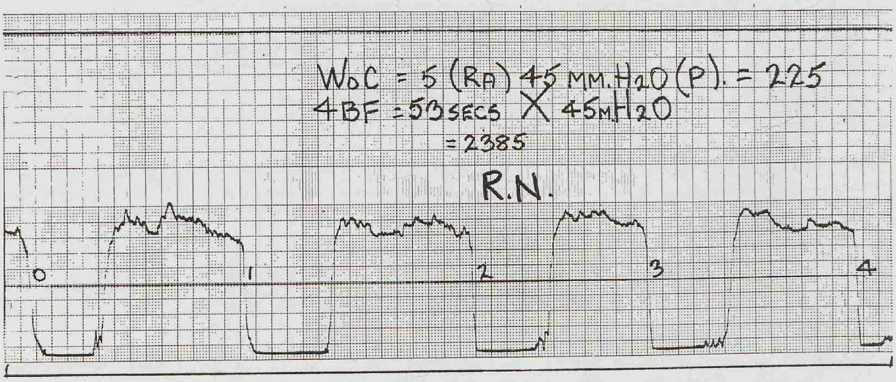


Figure 15. Work of breathing coefficient (WoC) is the pressure of inspiration multiplied by the rate of breathing per minute. The four breath factor (4 B.F.) is the duration of 4 breaths multiplied by the pressure of inspiration. The products (numbers) should closely approximate. The graph shows high pressures associated with a slow rate of breathing — evidences of a grossly abnormally functioning nose.

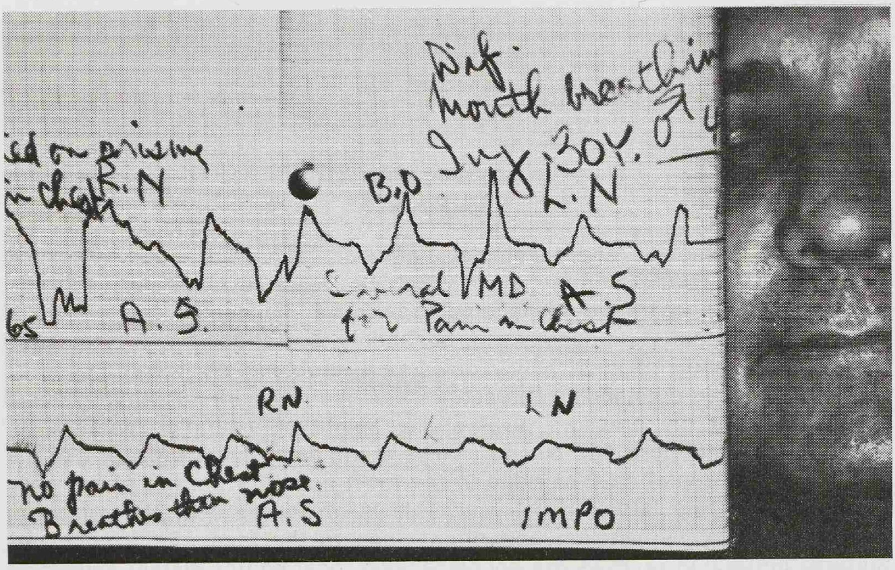


Figure 16. The lowered pressures, right and left, following surgery were accompanied by relief of chest pain and improved breathing.

is still causing a marked increase in breathing pressure to the detriment of the patient's health (Figure 17).

Patients are occasionally seen who have had slight or extensive injuries and even well performed operations for cosmetic or other reasons who develop significant pressure changes. With this in mind some alterations in the technic of surgical corrections suggest themselves to avoid the pitfalls of post-operative and post-traumatic sequelae, such as soft tissue

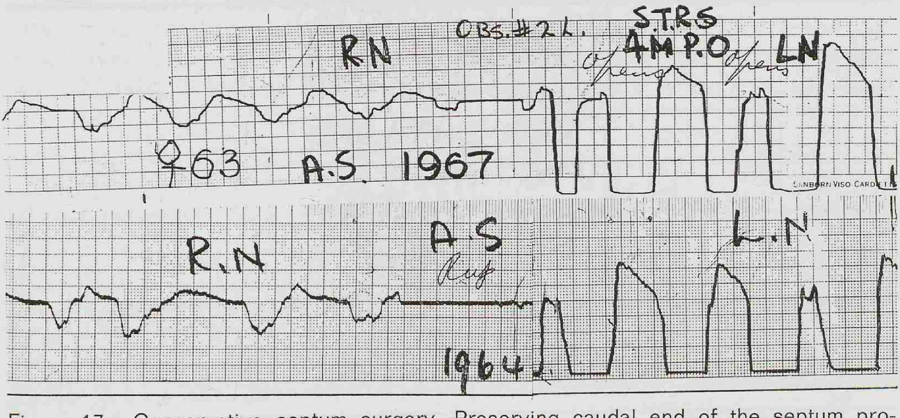


Figure 17. Conservative septum surgery. Preserving caudal end of the septum produced improvement of breathing through right nasal chamber, but left unaffected the septum deviation in the left valve area and the attendant serious increased pressure.

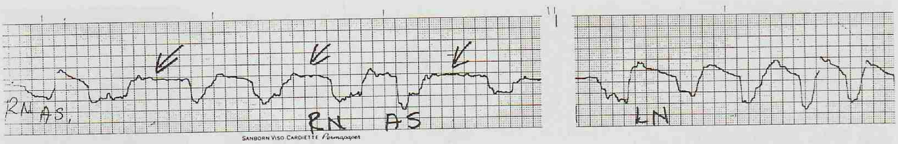


Figure 18. "Flat top". Long (3—5 seconds) pause at the height of expiration — on the right side only!! — the site of a marked septal obstruction.

thickenings, complete and incomplete atresias, synechiae, and excessive narrowing of normal structures, all of which can result in respiratory distress. A rigorous post-operative management must be maintained for months if necessary to avoid their occurrence; secondary operations might be needed for the eradication of such newly developed structural changes.

Group III — The outstanding characteristic of the pressure curves in group 3 is the fact that the pressure level at the height of **expiration persists** for 2 to 4 seconds (Figure 18). Nearly always this indicates the presence of the impaction of a septal spur or ridge in the most posterior portion of the nose impinging onto the lateral nasal wall. This is of course near the region of the spheno-palatine ganglion and often close to the face of the sphenoid. Surgical correction relieves the accompanying local and/or distant symptoms promptly, but the disturbed breathing patterns may persist for some time because as we have often observed, a respiratory pattern once set finds difficulty in returning to normal, though it usually does eventually. (The notable exceptions to this rule are the patients to be described in group 5.)

Group IV — In people placed in this group the inspiration and expiration **pressures are low** ranging between 3 to 5 millimeters of water and sometimes even less (Figure 19). One (or more) of three clinical entities are frequently found among these patients: (1) Patients with abnormally wide nasal chambers such as seen in marked nasal atrophies, or noses flattened

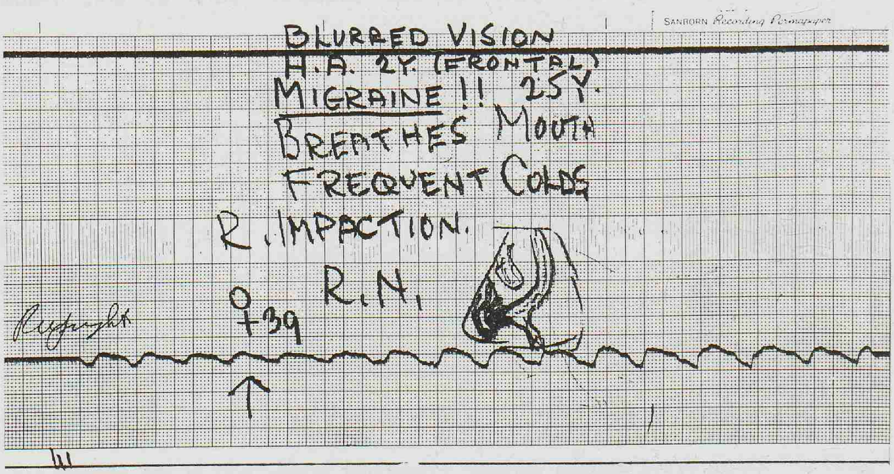


Figure 19. "Suppression". Marked diminution of amplitude of respiratory movements, especially on right, the site of a sharp septal impaction.

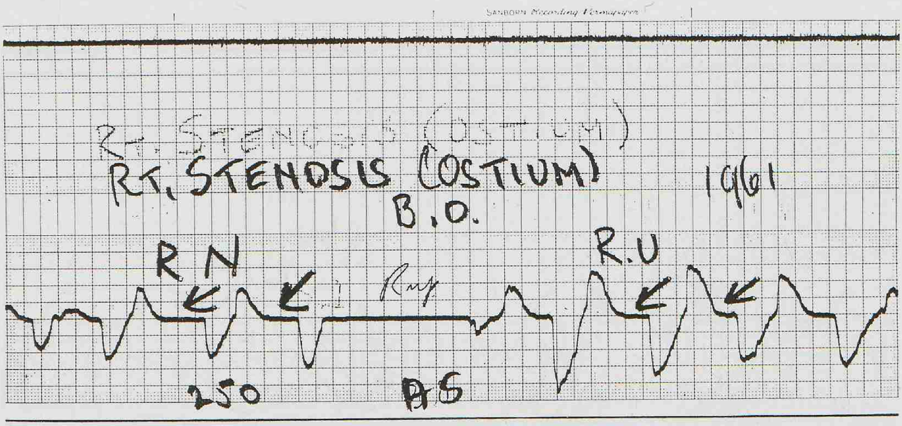


Figure 20. Mid-cycle rest. A pause at the conclusion of a breath lasting a second or more. Usually a permanent irreversible finding.

due to injury accompanied by secondary atrophy of the intranasal structures. (2) Obese, asthenic, and debilitated people with lowered metabolic activities. (3) Sharp septal spurs pressing on the lateral wall of a nose and other localized mucosal involvements seem to produce an extreme sensitivity of the nasal mucosa which in turn appears to initiate reflexes that suppress breathing — an attempt to prevent air from passing over its surface in any great amount or intensity. This is not only a neurologic reflex, but also involves the vascular beds. Migraine-like headache is often the outstanding complaint. It is remarkable to note on occasion that this recorded finding is marked on one side of the nose while on the other it is close to normal. Group V — The pressure curve here is distinctively different from all the others. After each breathing cycle is completed there is a pause of at least one full second during which there is no inspiration or expiration, no positive or negative pressure. This pause often lasts for 2 to 3 seconds and in extreme instances has been noted to last from 5 to 18 seconds. We have referred to this pause as a **mid-cycle rest** (M.C.R.) (Figures 20, 21 and 22). It is never a normal finding and is often seen in patients who have had difficult nasal breathing for several years and many who have not been


Figure 21. Mid-cycle rest. Same patient as Figure 20.

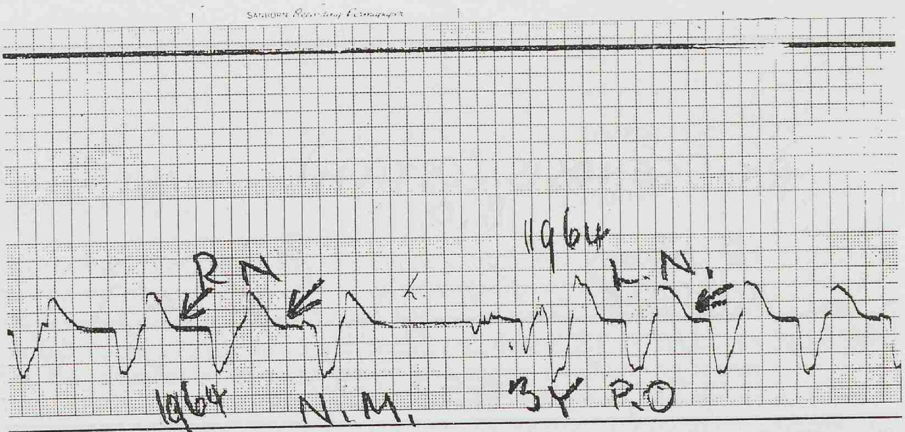


Figure 22. Mid-cycle rest. Three graphs recorded in 1961 (Figure 20), 1962 (Figure 21) and 1964 show constancy and persistence of disturbance.

particularly aware of the difficulty. If the breathing pressure is high in valve area obstruction or in lesser deformities during periods of nasal congestion as when the patient has a cold or an allergic rhinitis, the pause may be partially or completely obliterated from the graphs, but when the pressures return to lower limits the mid-cycle rest reappears. It occurs in all age groups including childhood.

It is also often encountered in people with recent or old heart disease, with or without discernible nasal pathology.

In our experience this breathing aberration has been essentially an irreversible finding with but few exceptions. We consider it to be a sign of a significant derailment of the respiratory function somewhere along the many pathways that provide for cellular oxygen metabolism and the elimination of carbon dioxide away from the tissues to the outside world.

### Other aberrations

There are other aberrations of pressure curves which have not been catalogued. One is "rapidity of breathing". This is often observed in children with adenoid obstruction (Figure 23). Similar rapid cycles occur in adults with pulmonary disease. The amplitudes may be fairly low or even quite high. Most often the cycles are regular and equal. Uneven and unequal rapid breathing patterns are often seen in emotionally disturbed people.

A person breathing less than ten breaths per second can be considered to be breathing slowly. Negus has stated that such slow breathing is always inadequate to assure good alveolar ventilation regardless of the amount of

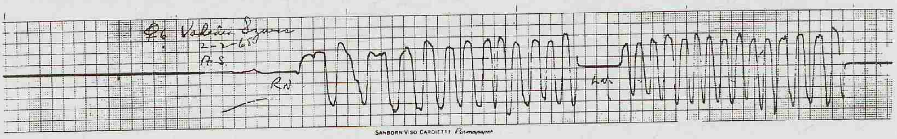

Figure 23. Rapid high pressure breathing seen in children with adenoid obstruction.

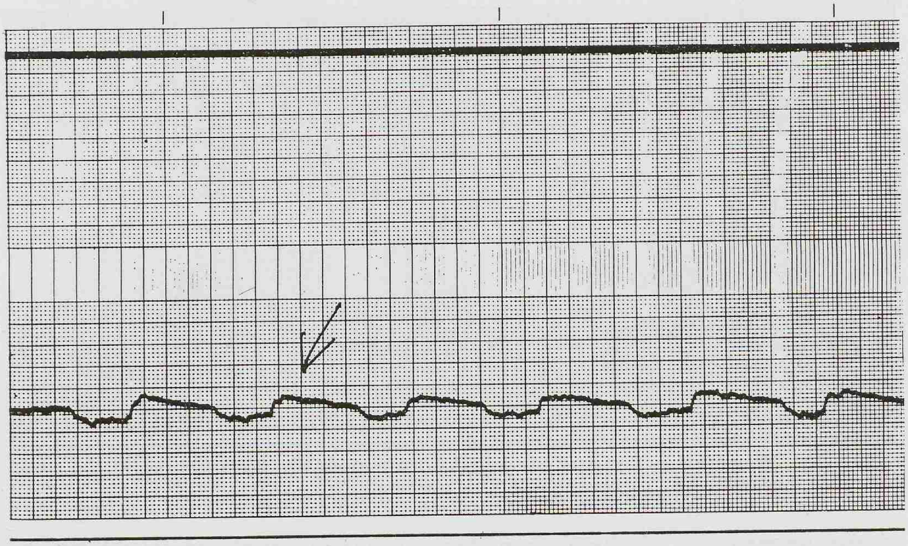

Figure 24. Slow breathing (less than 10 times per minute) with low pressures of inspiration and expiration.

air involved in the process. It occurs with low breathing pressures (Figures 24 and 25) in Caucasians with injured flattened and widened noses of long standing and with high pressures (Figure 15) in young people with nasal obstruction of long standing and frequently persists for a year or two after the obstructions are surgically corrected.

A prolongation of the duration of maximal inspiratory pressure is recorded rarely, but is always to be considered an aberration requiring further exploration.

## Nasal-antral pressure tests

Rhinologists use pressure determinations to evaluate the permeability of the natural ostium of the maxillary antrum. Normally the pressure within the sinus is exactly the same as in the corresponding nasal chamber showing all the usually positive and negative pressure changes accompanying breathing, blowing, and sniffing (Figure 26). If partial blocking of the aperture pertains, be it in the sinus, in the nasal chamber, or within the ostium itself, a diminution of antrum pressure is seen (Figure 27). When total obstruction exists, no pressure recording from within the sinus is obtainable (Figure 28). With changes

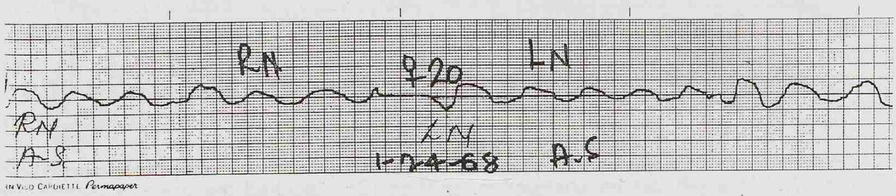


Figure 25. Irregular breathing with low pressures.

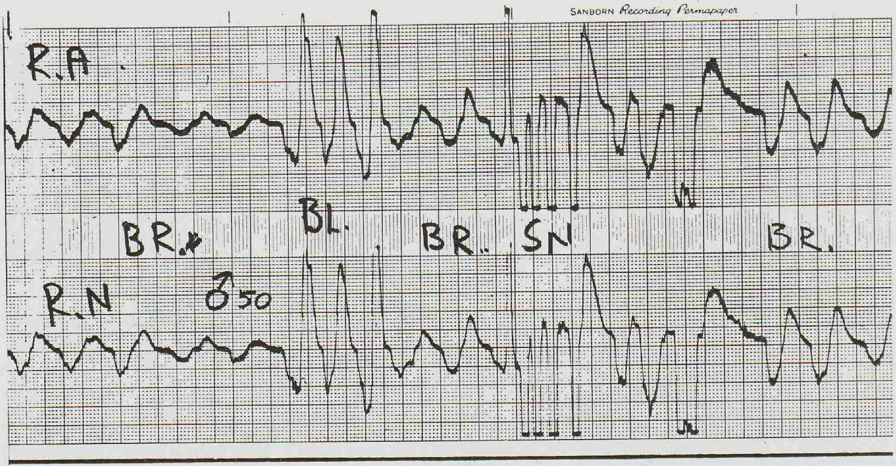


Figure 26. Pressures within the antrum (R.A.) are normally the same as in the nose (R.N.) on breathing (Br.), blowing (Bl.), or sniffing (Sn.).

of the permeability of the ostium there occurs a variety of symptoms including headache, sore throat, ear disturbances, cough, ocular discomforts, and irritability. Reestablishment of a functioning ostium is so frequently and quickly followed by relief of complaints that it is deemed of prime importance to bring this clinical entity to the attention of the profession. Maxillary ostium region incompetence (M.O.R.I.) most frequently gives no local regional manifestations and is, therefore, referred to by many as a "silent syndrome".

## DISCUSSION

Rhinologists encounter a host of patients with symptoms referred to all segments of the head and chest, and also quite frequently to other parts of the body. Often the complaints have persisted for many years and have resisted therapeutic measures for their alleviation and eradication.

They have also had the gratifying and oft repeated experience of seeing

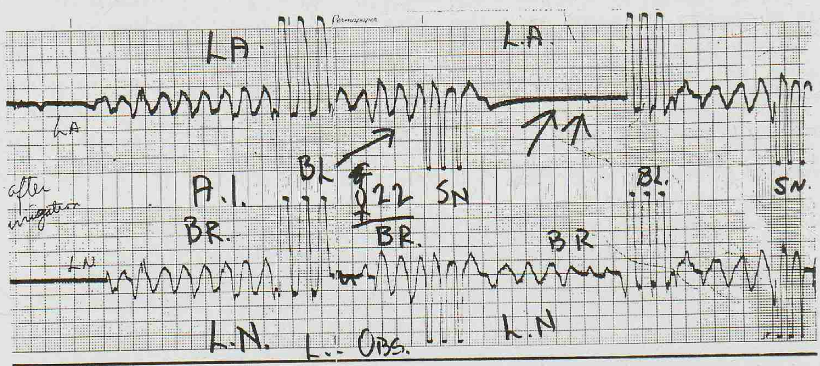


Figure 27. In a left ostium obstruction, sniffing (Sn.) blocked the opening completely while blowing (Bl.) reestablished normal pressures on quiet breathing (Br.).

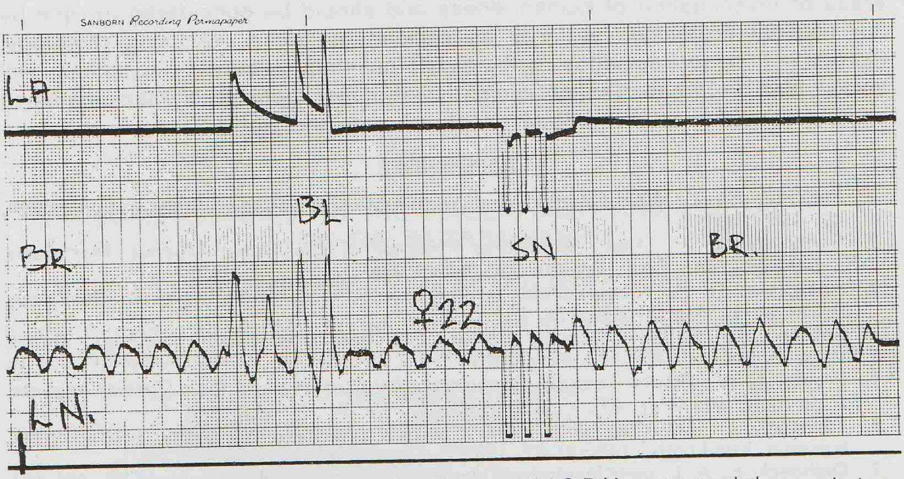


Figure 28. Maxillary Ostium Region Insufficiency (M.O.R.I.) maintained the respiratory impermeability of the ostium despite forceful blowing and sniffing.

these same people receive remarkable clinical benefits following nasal surgery, be it septum reconstruction, sinus operations, cosmetic corrections, and/or polyp and other benign tumor removals.

It may be revealing to enumerate and categorize some of the observations spontaneously reported by patients regarding their symptoms without their being directed or lead, but just in response to the simple question, "Have you something to tell about how you feel?".

**Breathing:** "No more difficult breathing", "Pain in chest gone", "No gasping, especially at night", "Asthma not present since operation", "Chest feels clean and open", "Cough has stopped", "No snoring", "More air in chest", "Do not struggle to breathe."

**Sleep:** "Had to use six to nine pillows before operation", "Can sleep on both sides", "No choking or cold sweats to disturb sleep."

**Work:** "Enjoys work", "Can work", "Much energy — no fatigue since surgery", "Can walk", "Not tired."

**Head:** "No headache or head pressure", "Can concentrate."

**"Psyche":** "More alert — feels alive", "Not depressed", "Not as nervous", "Does better in school."

Many other somatic and psychologic symptoms have been similarly noted. (22) On the other hand many of the same disturbances frequently have been first noted following the same sort of nasal operations.

To know which patients might be expected to derive such significant clinical benefits and why, and what surgical procedures may cause clinical disturbances requires wider understanding of nasal functions and their systèmic correlations and the availability of newer and perhaps more sophisticated diagnostic facilities.

## CONCLUSIONS

Nasal breathing pressure testing offers a significant contribution to important areas of investigation of human illness and should be considered for use by the medical profession at large as well as by those practicing rhinology. Correlating nasal activities with cardio-pulmonary-vascular functions will surely lead to greater enlightenment in the management of many common complaints of a vast number of people all over the world.

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