The Present Status of Phrenic Nerve Paralysis in the Treatment of Pulmonary Tuberculosis*

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The popularity of phrenic nerve paralysis as a collapse procedure in the treatment of pulmonary tuberculosis has intermittently waxed and waned for almost 40 years. There was a time when this operation was employed almost routinely in some institutions. Today, however, the procedure is utilized considerably less frequently and with more discrimination than in former times.

During recent years, the place of phrenic nerve interruption has become more and more that of an adjunct to other forms of collapse therapy, as for example, pneumoperitoneum. Moyer1 has recently pointed out the extreme value of this combination, pneumoperitoneum and phreniclasia, in certain cases. This appears to be especially true in the group of patients seriously ill with bilateral disease in which the only therapeutic alternative would be bed rest with or without antibiotic therapy. In his 550 patients, pneumoperitoneum was combined with temporary phrenic nerve interruption on the side most involved and excellent results were obtained in a large percentage of cases. Great caution is always advised in the use of a temporary phrenic paralysis in the presence of extensive bilateral disease. It must be remembered that the procedure is not always reversible and that on the average it takes six months before the function returns. There are times when the side with the lesser disease becomes the most important side to have at rest. If this situation develops, a rapid change in the plan of therapy is impossible.

Paralysis of the hemidiaphragm as a therapeutic measure in pulmonary tuberculosis was first performed by Stuertz2 in 1911. His original operations consisted of division or partial resection of the main phrenic nerve trunk in an effort to produce permanent paralysis. A large proportion of patients subjected to this operation (phrenicotomy) continued to have normal diaphragmatic movement, or soon had return of diaphragmatic function.

*Read as part of the Seminar on Tuberculosis presented by the Department of Medicine of the Graduate School of the University of Florida in cooperation with the Florida Medical Association, the Florida Tuberculosis and Health Association and the Florida State Board of Health, at Central Florida State Sanatorium, Orlando, Florida, May 24-26, 1950.
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This failure to produce paralysis in all cases by simple division was explained by Felix, and by Goetze, who independently demonstrated the presence of one or more accessory phrenic nerves in a large number of cases. They devised operations to bring about complete and permanent paralysis by means of interrupting not only the main phrenic trunk, but all accessory phrenic nerves as well. The main phrenic nerve typically arises from the third, fourth and fifth cervical roots while the smaller, so-called accessory phrenic nerves are actually small roots, as a rule, that arise from the fifth or possibly the fourth cervical root and join the main phrenic trunk more distally in its course. The clinical significance of these accessory roots is that if their connection with the diaphragm is not interrupted at the same time that the main phrenic trunk is paralyzed they may develop within a few days or months sufficient compensatory power to maintain partial or full motor function of the diaphragm.

Indications for Phrenic Paralysis

The indication for phrenic nerve operation, broadly considered, is essentially the same as for other forms of collapse therapy, namely, an active pulmonary lesion which might be expected to improve following pulmonary relaxation and rest. There is great individual variation in opinion among phthisiologists concerning the indications for this operation; in some clinics the procedure is used with great frequency whereas in other institutions it has been practically abandoned. Matson and Conklin state that phrenic nerve interruption may be considered under the following conditions:

1) As an adjunct to bed rest and sanatorium treatment in early lesions, especially those for which artificial pneumothorax is impossible.

2) In some cases with cavity in which artificial pneumothorax is the treatment of choice, but cannot be established, and who are not suitable for major surgery.

3) By some authorities it is considered the procedure of choice when the lower lobe is preponderantly involved. It is contraindicated, however, when there is associated suppurative disease, since it interferes with efficient expectoration.

4) Phrenic interruption may be used as an adjunct to artificial pneumothorax when inoperable adhesions interfere with collapse and other measures such as thoracoplasty are contraindicated.

5) Paralysis of the hemidiaphragm may be used to promote obliteration of the pleural cavity when an artificial pneumothorax is being discontinued.

6) In some cases of pleural effusion, phrenic paralysis may be
used to promote resorption of the fluid, obliteration of the pleural cavity, and control of underlying pulmonary pathology, especially when an adequate pneumothorax can not be established.

7) In empyema, phrenic paralysis may be used to promote obliteration, or to reduce the size of the infected pocket prior to thoracoplasty.

Many authorities today would not agree with some of the indications given above, as for example number 4. When inoperable adhesions interfere with adequate collapse, an artificial pneumothorax should probably be immediately abandoned rather than attempt to improve the situation by diaphragmatic paralysis. Pneumothorax as a collapse procedure is now used much less commonly than formerly, thus the indications for phrenic paralysis as originally outlined by Matson and Conklin a few years ago must now be considered in this light. Also, this procedure is rarely used today in cases of pleural effusion (number 6).

Generally speaking, the operation may be used for any lesion upon which moderate relaxation and rest of the affected lung might reasonably be expected to exert a beneficial effect. This would probably include certain early lesions which should not be trusted to bed rest alone, and selected instances of small, thin-walled cavitary lesions. The individual phthisiologist's experience with this procedure will, of course, be of utmost importance and will probably be the deciding factor in determining which cases he selects for phreniclasia.

There are certain special situations in which phrenic paralysis has been used with considerable value such as to control pulmonary hemorrhage, to control persistent hiccough, to relieve diaphragmatic spasm, and to facilitate certain intrathoracic or intra-abdominal operations, i.e., repair of diaphragmatic hernia. The use of phreniclasia in conjunction with pneumoperitoneum has previously been mentioned and this now constitutes the principle indication for its use in many institutions. Trimble and his associates, on the other hand, feel that it is rarely necessary to employ this procedure as an adjunct to pneumoperitoneum and believe it is definitely harmful in many instances.

There are many contraindications to the use of phrenic paralysis. These may be briefly summed up by stating that it should not be used if the amount of disease present in one or both lungs or the presence of any other factor or combination of factors has so greatly lowered the patient's vital capacity that the further reduction of respiratory reserve caused by phrenic paralysis might cause respiratory insufficiency. In addition, the long-range plan of therapy in each case must be considered, and if it is anticipated that major surgery such as thoracoplasty or resection may later
be required, it would probably be prudent to withhold phrenic nerve operation. Then, too, in elderly or emphysematous patients, this operation must be undertaken only after thoroughly evaluating pulmonary reserve. In the presence of endobronchial disease with or without stenosis, the additional angulation produced by diaphragmatic elevation resulting from phrenic nerve paralysis may be sufficient to interfere with adequate drainage and may convert an unblocked cavity into a blocked or tension cavity. This mechanism explains why cavities may enlarge in certain instances following phreniclasia.

Other than excessive reduction in respiratory function, the only significant complication of phrenic paralysis is gastro-intestinal distress ("phrenic dyspepsia"). This condition is not commonly seen and is rarely of serious significance.

Temporary Versus Permanent Phrenic Paralysis

Although permanent paralysis of the hemidiaphragm was the procedure employed for many years by means of avulsing or severing the nerve, this has now largely been replaced by temporary paralysis. This is produced by a simple crushing of the nerve. Paralysis induced in this manner usually persists from four to eight months. The nerve may then be recrushed if indicated, and this occasionally is performed a third time. Unfortunately, diaphragmatic function fails to return, either partially or completely, in a certain percentage of cases. Thus, temporary phrenic paralysis is not an entirely innocuous procedure and one must approach it with the realization that there exists a definite risk of permanent diaphragmatic paralysis. In a recent study of this subject from the patients in residence at the Veterans Administration Hospital, Oteen, North Carolina, it was found that 53.5 per cent of patients who had undergone phreniclasia were left with some degree of permanent paralysis varying from slight to complete.

Technique of Operation

The details of the operative procedure will be described only briefly. Under local anesthesia, a 3 cm. incision is made parallel to the clavicle and 2 cm. above it with the midportion of the incision overlying the lateral border of the sternocleidomastoid muscle. The subcutaneous tissue and platysma are divided and the pre-scalene fat pad is penetrated. Care must be taken to avoid the external jugular vein which sometimes crosses the line of incision. Once the pre-scalene pad of fat has been divided, the phrenic nerve is usually readily recognized crossing the rounded belly of the scalenus anticus muscle. The fifth cervical root of
the brachial plexus is situated lateral to the muscle and is usually explored first to determine the presence or absence of accessory phrenic nerves. If found, these are divided unless quite large, in which case they are crushed. The main phrenic nerve is then crushed by means of a single firm application of a hemostatic forceps. This is rather important inasmuch as repeated clamping and chewing on the nerve undoubtedly greatly increases the incidence of permanent paralysis in these cases. The wound is usually closed with a few interrupted sutures of fine catgut for the muscle and a continuous subcuticular catgut suture for the skin. As an alternate either interrupted silk sutures or skin clips may be used to approximate the skin. Immediate post-operative fluoroscopy is performed to determine the degree of paralysis obtained. This is evidenced by elevation of the hemidiaphragm, absence or diminution in excursion, and paradoxical movement produced by sniffing.

SUMMARY

Temporary phrenic paralysis is occasionally indicated in certain selected cases in the modern treatment of pulmonary tuberculosis. This should only be performed following a consideration of the patient's long-range plan of therapy and possible future major surgical requirements. Permanent phrenic paralysis has very little place in the present-day treatment of pulmonary tuberculosis. However, the fact must be borne in mind that a definite percentage of attempted temporary phrenic paralyses will result in some degree of permanent impairment of diaphragmatic function.

RESUMEN

Ocasionalmente, la parálisis del frénico puede estar indicada en ciertos casos de tuberculosis pulmonar. Esta operación debe llevarse a cabo solo en vista de las escasas posibilidades terapéuticas del enfermo y en vista de la posibilidad de requerirse cirugía mayor en el futuro. La parálisis frénica permanente tiene poca aplicación en el presente en el tratamiento actual de la tuberculosis pulmonar. Sin embargo, debe tenerse presente que un porcentaje definido de parálisis del frénico temporal resultan en cierto grado de trastorno de la función del diaphragma.

RESUME

Dans le traitement moderne de la tuberculose pulmonaire il existe encore certains cas particuliers pour lesquels une paralysie temporaire du phrénique reste indiquée. Une telle décision ne peut être prise qu'en considérant un traitement de longue haleine du malade, et les exigences possibles d'un acte chirurgical important
dans le futur. La paralysie définitive du phrénique n'a qu'une très petite place dans le traitement moderne de la tuberculose pulmonaire. Toutefois, il faut avoir à l'esprit la notion que dans un nombre de cas assez important de paralysies phréniques exécutées pour n'être que temporaires, la fonction diaphragmatique peut être dans une certaine mesure définitivement touchée.

REFERENCES