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UNILATERAL PHRENIC NERVE PALSY: MANAGEMENT BY TRANSCUTANEOUS PHRENIC NERVE STIMULATION

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Zusammenfassung

Isolierte einseitige Phrenicusparese ist eher selten. Neurophysiologische Untersuchung der phrenico-diaphragmalen Funktion kann meist in allgemeinen Spitälern nicht durchgeführt werden, röntgenologische Verifikation aber doch. Daher wird nach Literaturübersicht ein Fall vorgestellt, bei dem radiologische Diagnostik Klärung der Symptome (Atemnot) brachte. Die rechte Zwerchfellhälfte war unbeweglich. Nach Elektrostimulation des rechten N. phrenicus setzte auf Bemühungen tiefer Atmung die Zwerchfellbewegung wieder ein.

Schlüsselwörter

Phrenicuslähmung, Phrenicusreizung, elektrische Nervenreizung.

Summary

Isolated unilateral phrenic nerve palsy is rather rare. Neurophysiological testing of phrenic nerve function is hardly possible in an average hospital, but radiological diagnosis is feasible. After review of relevant literature, a case is presented. After radiographic diagnosis of right phrenic nerve paralysis, transdermal stimulation of the phrenic nerve is initiated. Then the patient is asked to breathe deeply. While before stimulation this did not lead to any motion of the diaphragm, now extensive motion of diaphragm ensues.

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Key words

Phrenic nerve palsy, phrenic nerve stimulation, electrical nerve stimulation.

Résumé

Une paralysie unilatérale du nerf phrénique est très rare. Une examination neurophysiologique n'est point possible dans des hôpitaux généraux. Mais la diagnose par la méthode radiologique est possible en tout cas. Pour cette raison, après une aperçu de la littérature, on présente un cas d'une paralysie droit du phrénique. Après initiant une stimulation du nerf phrénique droit l'effort du malade d'inspirer avec force résulte dans une mouvement effectivement du part droit du diaphragme.

Mots clés

Paralysie du nerf phrénique, stimulation du nerf phrénique, stimulation électrique du nerf.

Isolated unilateral phrenic nerve palsy is a very rare occurrence. Usually, this occurs as one of the symptoms of various diseases of higher parts of the cervical cord or medulla, such as ascending myelitis, compression of cord by tumors (meningeomas) or traumata (hematoma), metastatic lesions of vertebral bodies or muscular atrophy or polyneuritis. If all these causes are examined and none found, a diabetic neuropathy may be the cause. Symptoms of unilateral paresis of the phrenic nerve are easily diagnosed: asymmetry in respiratory excursions of the thorax, ascertained by radiological study; high standing diaphragmal dome lacking respiratory motion on the affected side (see Fig.1). Shortness of breath and some dyspnoea with strenuous activities is noted, sometimes followed by bronchitic changes because of coughing becoming difficult or incomplete in the lower parts of the lung on the side of the paresis, decreasing expectoration.

Diaphragmatic weakness very often leads to respiratory insufficiency with all its sequels such as atelectases following surgery (WILCOX, 11) and is reported to be a pulmonary manifestation of lupus erythematosus (WILCOX, 12). Already relatively old literature (STRUEMPELL, 9) advised "faradic or galvanic current, the latter with changes in polarity" for this ailment.

In patients suffering from phrenic paralysis of respiratory muscles, pacemakers for electric stimulation of the phrenic nerves, so-called diaphragm pacers, are available for surgical implantation (FODSTAD, 3; their use has also been reported to be successful for chronic hiccup; FODSTAD, 2). Transcutaneous stimulation of phrenic nerves has been reported (JAMES, 4; MIRKAND, 5, TALONEN, 10). This method has been in use for physiological studies on phrenic-diaphragmatic function in normals (SMITH, 8) and in cases of severe respiratory insufficiency (MOORTY, 7). However, it is sometimes considered to be difficult and unreliable (MIER, 6).

Since it may not be possible to determine phrenic conduction time reliably in all hospitals, we felt that radiological documentation of action of phrenic stimulation should be tried because it would be possible everywhere. One case of respiratory insufficiency of two weeks duration due to lack of unilateral diaphragmatic mobility and its therapy with transcutaneous phrenic nerve stimulation and radiologic documentaion of

action shall be presented here.

A 54 year old female patient was referred to our pulmonary function laboratory for diagnostic evaluation of respiratory insufficiency. It became evident that the right portion of the diaphragm was immobile. Fig. 1 presents the ap. view of the thorax showing typical high position of the immobile diaphragm on the right side. Even forceful inspiration did not move the diaphragm. Before considering to refer the patient to another hospital (where long waiting lists prevail) for neurophysiological studies of phrenic-diaphragmatic function and before considering invasive stimulation of the phrenic nerve either by an insulated needle or by implantation of a pacer, we decided to observe if transcutaneously applied electrodes would be of any avail. For this purpose, a small cathode was applied over the right phrenic nerve in the neck over the skin. A large anode was applied over the dorsal spinous processes of C-6 and 7 and Th 1 and 2. Stimulation characteristics of the 'KRIEGER TNB-K4' unit used for stimulation was a DC pulse train of 0.1 msec pulse width, using a frequency of 100 cps*. Figs. 2 and 3 show the position of the small cathode with the usual distortion of position of peripherally located objects. With the stimulation on, the patient was asked to breathe deeply, as she was told to do previously to document diaphragmal immobility. This time, the diaphragm was not immobile, but moved in the normal respective way as would be naturally occurring when inspiration (Fig. 2) and expiration (Fig. 3) takes place. On the figures, the electrode (cathode) is clearly visible as a shadow.

Since this observation seemed to indicate to us that this nerve may be functioning after all, we felt that it was worth a therapeutic trial with these impulses once a day for 20 minutes. The patient obtained a home unit and had to stick to this regimen for one month. After this treatment schedule was completed, we followed up and saw that the diaphragm now moved again even without stimulation, and respiratory insufficiency no longer existed. For scientific purposes, neurophysiologic testing of diaphragmal-phrenic function is definitely required, but for practical purposes in a general hospital, radiological diagnosis suffices to warrant a trial with transcutaneous stimulation of the phrenic nerve using the characteristics of current we mentioned to ascertain success.

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* Please note reversed polarity and different frequency as compared to pain therapy usage.

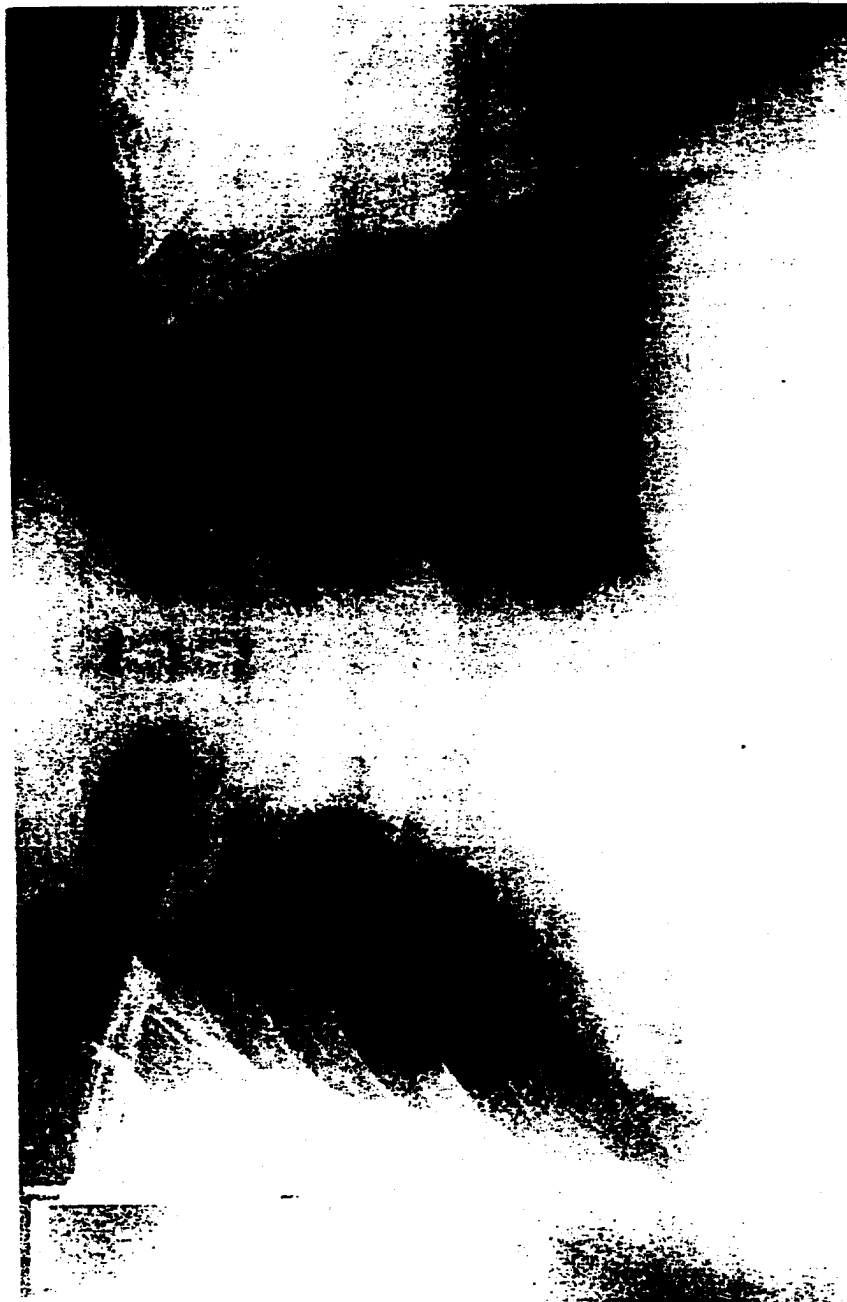


Figure 1: Ap. view of thorax. Note typical high position of the immobile diaphragm on right side.



Figure 2: Inspiration phase
(Note position of small cathode in both figures)

Figure 3: Expiration phase
(Note position of small cathode in both figures)

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