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BILATERAL DIAPHRAGMATIC PARALYSIS AND LYME NEUROBORRELIOSIS. TEN-YEARS OF FOLLOW-UP

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Abstract *Borrelia burgdorferi* infection (Lyme disease) is one of the few identifiable causes of neuralgic amyotrophy (AN). Bilateral diaphragmatic paralysis is considered rare in borreliosis, and the pattern of long-term recovery of diaphragm function is also uncertain. Transdiaphragmatic pressure is the gold standard for diagnosing bilateral diaphragmatic paralysis, a study that has been reported on a few occasions. We present a case of AN associated with borrelia infection and bilateral diaphragmatic paralysis that provides a detailed follow-up of the spirometric evolution, the maximum static pressures in the mouth, and the transdiaphragmatic pressure from the onset of symptoms and in the long term. This case allows us to know one of the possible evolutionary profiles of diaphragmatic dysfunction in AN due to borreliosis.

Key words: brachial plexus neuritis, Lyme disease, respiratory paralysis, noninvasive ventilation

Resumen ***Parálisis diafragmática bilateral y neuroborreliosis de Lyme. Diez años de seguimiento.*** La infección por *Borrelia burgdorferi* (enfermedad de Lyme) es una de las pocas causas identificables de amiotrofia neurálgica. La parálisis diafragmática bilateral es considerada rara en la borreliosis y el patrón de recuperación a largo plazo de la función del diafragma también es incierto. La presión transdiafragmática es el patrón de oro para el diagnóstico de parálisis diafragmática bilateral, un estudio que ha sido informado en pocas ocasiones. Se presenta un caso de amiotrofia neurálgica asociado a infección por Borrelia y parálisis diafragmática bilateral, que aporta un seguimiento detallado de la evolución espirométrica, de las presiones estáticas máximas en la boca y de la presión transdiafragmática desde el inicio de los síntomas y a largo plazo. Este caso permite conocer uno de los posibles perfiles evolutivos de la disfunción diafragmática en la amiotrofia neurálgica por borreliosis.

Palabras clave: amiotrofia neurálgica, enfermedad de Lyme, parálisis respiratoria, ventilación no invasiva

Neuralgic amyotrophy (AN), also known as Parsonage-Turner syndrome, paralytic brachial neuritis, idiopathic brachial plexopathy, brachial plexus neuropathy, or acute brachial radiculitis, is an entity that affects the brachial plexus. In the UK it is estimated at around 1-3 / 100,000 inhabitants / year[1]. In addition, *Borrelia burgdorferi* infection (Lyme disease) is a rare but potentially treatable cause of AN[2].

Bilateral diaphragmatic paralysis is considered rare in Lyme disease[3, 4]. The long-term recovery profile of diaphragm function is uncertain; it has been described from a substantial improvement to the need to use long-term mechanical ventilation[3, 4]. The gold standard for the diagnosis of bilateral diaphragmatic paralysis is the determination of transdiaphragmatic pressure (Pdi)[5, 6], a study that has been reported on few occasions.

We present a case of AN associated with Borrelia infection and bilateral diaphragmatic paralysis that provides a detailed follow-up of the spirometric evolution, the maximum static pressures in the mouth and the transdiaphragmatic pressure from the onset of symptoms and in the long term. This case allows us to know one of the possible evolutionary profiles of diaphragmatic dysfunction in AN due to borreliosis.

Clinical case

A 63-year-old woman with arterial hypertension (medicated with enalapril 10 mg / day) and obesity (BMI 38.5 kg/m^2). She consulted for neck pain, shoulder girdle and both upper limbs and functional impotence of 48 hours of evolution. The pain was of sudden onset, continuous, of intensity 10/10, without an antalgic position. She had no history of viral infection, recent

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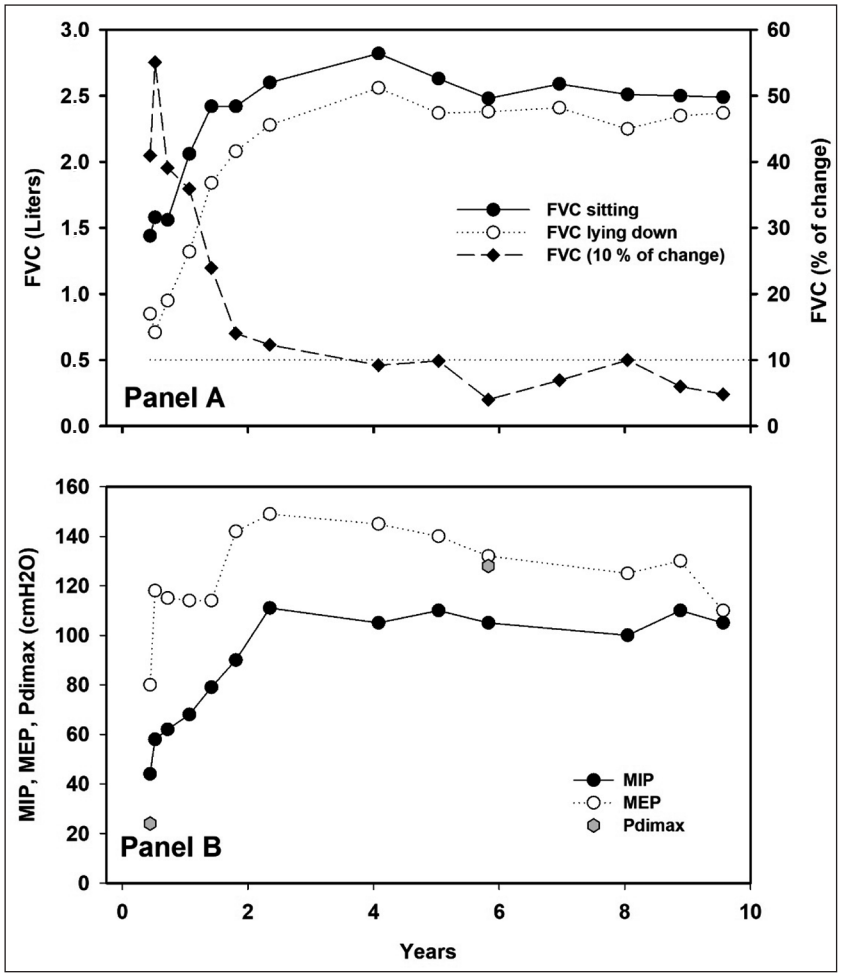
vaccination, strenuous exercise, surgery, trauma, or a family history of hereditary AN. The pain partially improved with the administration of 5 mg subcutaneous morphine, but it evolved with orthopnea and O_2 desaturation. On physical examination, she had 36.5 °C and blood pressure of 130/80 mmHg. Examination of muscle strength showed weakness (4+/5) in bilateral shoulder abduction and distal weakness in common extensor digits (4+/5); in left upper limb. She had pain and dysesthesia in the periscapular region and bilateral upper limbs without defined distribution and winged scapula. Deep sensitivity and tendon reflexes were preserved, the cranial nerves and taxia were normal. There were no fasciculations or atrophy.

The respiratory examination showed the use of accessory neck muscles, a respiratory rate of 20 bpm, decreased air intake at both bases, orthopnea, and paradoxical breathing of the abdomen. The chest radiograph showed elevation of both hemidiaphragm. The fluoroscopy showed the absence of mobility of the right hemidiaphragm and a marked decrease in the excursion of the left hemidiaphragm. Seated arterial blood gas (FiO_2 0.21) showed SaO_2 96%, PaO_2 75.3 mmHg, $PaCO_2$ 33.3 mmHg, pH 7.45, bicarbonate 22.6 mEq/l, (A/a) PO_2 33.4 mmHg, lactate 1, 8 mmol/l. The rest of the routine laboratory tests were normal. Pulmonary function tests showed a seated forced vital capacity (FVC) of 1,440 ml (47% predicted[7]); the fall in supine position was 41%. The FEV_1/FVC ratio was 93%. The maximum inspiratory and expiratory pressures (MIP and MEP) were 44 cmH_2O (63% predicted) and 80 cmH_2O (104% predicted), respectively[8]. Maximum transdiaphragmatic pressure (Pdi) was 24 cmH_2O (19% predicted). The maximum Pdi of the last control performed (Figure 1) was 128 cmH_2O (105% predicted)[9].

Neurophysiological studies showed prolonged distal motor latencies and reduced compound muscle action potential amplitude in both median nerves. In the left median nerve, the sensory latency was prolonged, and the amplitude of the sensory nerve action potential was reduced. Spontaneous activity was observed in the electromyography in the supraspinatus, triceps, biceps, common extensor of the left fingers and serratus anterior. Stimulation of the phrenic nerves in the neck evoked no compound muscle action potential or discernible mechanical response (bilateral inexcitability).

The cerebrospinal fluid (CSF) presented lymphocytic pleocytosis in two lumbar punctures. IgM-IgG anti-*Borrelia burgdorferi* seroconversion was determined. Initially weak positive

Fig. 1.– Respiratory functional studies. A: Forced Vital Capacity (FVC) sitting (y-axis from the left) and the percentage of change between both measurements (y-axis from the right). The horizontal dotted line corresponds to the normal upper limit of the FVC drop. B: maximum inspiratory (MIP) and expiratory (MEP) pressures. The two determinations of maximum transdiaphragmatic pressure (Pdimax) are observed at baseline and six years



IgM and positive IgG with a titer of 1/160, while at 30; 45 and 90 days' serum IgM titers were negative, while those of IgG were 1/640; 1/1460 and 1/1280.

Initial treatment with non-steroidal analgesics and opiates produced mild pain relief, while there was a significant decrease with meprednisone 80 mg/day and doxycycline 100 mg BID. Due to the presence of orthopnea and desaturation, non-invasive ventilation (IPAP/EPAP 18/4 cmH_2O respectively) was indicated, with clear improvement in ventilatory mechanics and orthopnea. The respiratory functional evolution of the maximum mouth pressures and the Pdi is observed in Figure 1.

The patient evolved favorably, with improvement in pain and functional impotence within a week and was discharged with indications for early and individualized rehabilitation that she did not comply with. After six months, she presented mild persistence of pain in the cervico-dorsal region and reduced BiPAP requirements from 12 hours to 6 hours a day at night. At eight months the muscle strength in the upper limbs was 5/5. At 16 months, after the event, she stopped requiring BiPAP; she did not report orthopnea, although functional recovery was not complete (Fig. 1).

Discussion

This case of AN associated with Borrelia infection and bilateral diaphragmatic paralysis allows us to know one of the possible evolutionary profiles of diaphragmatic dysfunction in this condition.

The abrupt onset with severe pain followed by irregular weakness in the distribution of the brachial plexus and the presence of denervation on EMG were consistent with AN[10]. The diagnosis of Borreliosis was made based on CSF findings and seroconversion. Antibody tests against *B. burgdorferi* should be considered an adjunct to clinical diagnosis since they cannot establish or exclude the diagnosis of Lyme disease by themselves. In our case, the finding of seroconversion and the clinical picture support the diagnosis of Lyme disease.

Our patient resided in Buenos Aires, and her last trip outside the city (Misiones province) was 18 months ago. In Argentina, Stanchi et al. identified antibodies against *B. burgdorferi* in a group of agricultural workers with arthritis, while Cicuttin et al. reported Borrelia spp. in ticks and birds of a protected urban area in the city of Buenos Aires[11,12].

The orthopnea, a fall of more than 30% in FVC in the supine position, was compatible with bilateral diaphragmatic paralysis[11]. Low MIP and the need for BiPAP are in line with that diagnosis. The maximum Pdi less than 30 cmH_2O confirmed the presumption of diaphragmatic paralysis[5, 13]. The maximum Pdi is an invasive study and careful attention to the details of the technique is required to obtain reliable measurements. The measurement of the Pdi_{max} remains the gold standard of bilateral diaphragmatic paralysis[6, 14]. Unlike other neurophysiological and imaging techniques, Pdi_{max} provides an objective measure of the pressure developed by the diaphragm; its value is proportional to the force generated by it[5, 11, 14], while it is not possible to predict Pdi response values from the recording of the compound action potential of the diaphragm, or the ultrasound of the diaphragm[6].

A recent study modeled the course of recovery from NA diaphragm dysfunction not associated with borreliosis[15]. Only 31% of their 16 subjects studied achieved normal FVC, and even those with apparent full recovery had residual diaphragm deterioration on more detailed testing. The recovery course was prolonged, with a time to midpoint of recovery of almost two years. The authors did not report other identifiable etiologies[15]. With the diagnosis of borreliosis, there are a few cases of bilateral diaphragmatic paralysis. In such cases, the magnitude and recovery time of the diaphragm were not reported[3, 4, 16].

In our case, it was possible to carry out clinical follow-up and various respiratory variables from the onset of symptoms and over ten years (Fig. 1). At four years after the onset of the disease, recovery was complete. Although it is speculative, it is possible to observe that both the recovery of the FVC, the difference between the FVC sitting and lying down and the maximum static pressures evolved with a substantial improvement in the first phase of follow-up and in a non-linear way. Unfortunately, we do not yet have other similar data to establish trends or evolutionary patterns. The patient used nocturnal NIV and, with the respiratory functional improvement, orthopnea ceased and was able to dispense with the nocturnal ventilatory support.

This clinical case of bilateral diaphragmatic paralysis due to AN due to borreliosis reaffirms the importance of studying the causes that can produce AN and provide a detailed follow-up of the recovery of the diaphragm in the long term that allows establishing one of the possible evolutionary patterns of said recovery.

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