RESTORATION OF PHRENIC NERVE ACTIVITY IN A PRE-TERM NEWBORN USING LASER THERAPY

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A girl delivered at 29 weeks gestation developed a left-sided pneumothorax which required chest drainage. Electrophysiological studies showed ipsilateral phrenic nerve injury and an ultrasound scan confirmed diaphragmatic paralysis. She was dependent on mechanical ventilation for 31 days. Laser therapy (HeNe, 35 mW) was applied transcutaneously for 45 minutes each day for 14 days to the left side of the neck at the site of the anatomical projection of the phrenic nerve. This resulted in restoration of phrenic nerve activity.

Key words: Phrenic nerve palsy, pre-term infant, tension pneumothorax, HeNe LLLT, diaphragmatic eventration

Introduction

According to Seddon's classification,⁽¹⁾ interruption of peripheral nerve activity may result from three conditions, listed from most to least severe: severance of the nerve (neurotmesis); interruption of axons and their myelin sheaths (axonotmesis) with a grossly intact nerve trunk; or by the cessation of neural activity while the nerves still retain their continuity with no axonal degeneration (neuropraxia). Severity of nerve damage determines the likelihood of recovery. That being so, it could be assumed that while neurotmesis will almost always result in permanent neural dysfunction and axonotmesis may result in persistent paralysis but with partial improvement over time, the prognosis for neuropraxia lesions is much more favorable with complete recovery expected over time.

Previous studies from Rochkind et al.⁽²⁻¹¹⁾ have indicated that laser therapy may have potential beneficial effects on limitation of damage to and repair of the peripheral and central nervous systems. In these controlled studies, laser therapy promoted restoration of the electrophysiological activity of severely injured peripheral nerves, prevented degenerative changes in neurons of the spinal cord and increased proliferation of

astrocytes and oligodendrocytes. These findings in controlled trials suggested photostimulation of a higher neuronal metabolic rate in addition to improved ability of myelin production and sheath repair under the influence of laser therapy. In view of the potential beneficial effects of laser treatment, we decided to use this noninvasive therapeutic modality in a pre-term infant suffering from a left phrenic nerve injury associated with diaphragmatic paralysis and failure of weaning from mechanical ventilation. We report herein on this case.

Case Report

A girl was delivered at 29 weeks gestation by Caesarian section because of foetal distress. She weighed 1180 g, and her Apgar scores were 7 and 8 at 1 and 5 minutes, respectively. She became tachypneic shortly after birth and by 1 hour of age was intubated and ventilated using conventional mechanical ventilation. A chest X-ray was compatible with respiratory distress syndrome. Two doses of exogenous surfactant preparation (Exosurf, Wellcome Foundation, UK) were administered at 2 and 10 hours of age. On the second day of life she developed a left-sided tension pneumothorax which required a percutaneous chest tube inserted without the trocar

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(10F Argyle catheter, Sherwood Medical Products St. Louis, Mo, USA). The air leak sealed by day 3 and the chest tube was removed. On day 8 an attempt at weaning the patient from mechanical ventilation failed. On repeated chest X-rays, eventration of the left hemidiaphragm was demonstrated. Ultrasound of the diaphragm during spontaneous breathing showed poor excursion of the left hemidiaphragm which was confirmed by fluoroscopy. Evoked response potential assessment of left phrenic nerve conduction was carried out. Recordings were performed over the sixth intercostal space on the anterior axillary line. This was carried out on day 15 and there was no recordable potential. The left median nerve action potentials were normal. Low power laser irradiation was started on day 16.

Laser Therapy Protocol

Laser irradiation (HeNe, continuous wave, 632.8 nm, 35 mW) was applied transcutaneously on the anatomical projection of the phrenic nerve in the C4 nerve root area 45 minutes each day for 14 days.

The infant was ventilated for 31 days and required oxygen via nasal prongs until day 48. After extubation, ultrasound showed normal diaphragmatic excursion. She was discharged home on day 69. On follow-up at 2 years of age, she was thriving well without respiratory problems. Diaphragmatic ultrasound and phrenic conduction study was normal.

Discussion

Phrenic nerve injury following pneumothorax and chest drain insertion is a known complication of the neonatal period.⁽¹²⁻¹⁴⁾ Direct damage afflicted to the phrenic nerve within the mediastinum by a malpositioned chest tube seems to be a very unlikely explanation. Stretching of the phrenic nerve by tension pneumothorax thereby increasing the distance from the origin of the nerve to its insertion would be a more plausible explanation.⁽¹³⁾ Surgical intervention has been the treatment of choice for diaphragmatic eventration. However, this treatment may cause persistent diaphragmatic disability and pulmonary dysfunction.⁽¹⁵⁾ Since several studies have shown that laser therapy may accelerate resolution of peripheral nerve damage as well as central nervous system damage,⁽²⁻¹¹⁾ laser irradiation was applied to our patient. This modality of treatment resulted in *restitutio ad integrum* of phrenic nerve activity allowing rapid weaning from mechanical ventilation. Although it is impossible to separate the effect of time (natural course) from the effect of laser therapy in this one case report, the authors firmly believe from past experience that the laser therapy accelerated any spontaneous recovery. Because laser therapy is noninvasive, easy to apply, painless and well-tolerated even by neonates, the authors suggest that laser therapy should, as a matter of course, be tried on every infant

with phrenic nerve palsy requiring mechanical ventilation.

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