Healing of Amyotrophic Lateral Sclerosis: A Case Report

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Keywords
Amyotrophic lateral sclerosis · Progressive muscular atrophy · Motor neuron disease · Chelation therapy · Mercury · Heavy metals

Summary
Background: Amyotrophic lateral sclerosis (ALS) is a devastating disease leading to death within 3–5 years in most cases. New approaches to treating this disease are needed. Here, we report a successful therapy. Case Report: In a 49-year-old male patient suffering from muscle weakness and fasciculations, progressive muscular atrophy, a variant of ALS, was diagnosed after extensive examinations ruling out other diseases. Due to supposed mercury exposure from residual amalgam, the patient’s teeth were restored. Then, the patient received sodium 2,3-dimercaptopropanesulfonate (DMPS; overall 86 × 250 mg in 3 years) in combination with \(\alpha\)-lipoic acid and followed by selenium. In addition, he took vitamins and micronutrients and kept a vegetarian diet. The excretion of metals was monitored in the urine. The success of the therapy was followed by scoring muscle weakness and fasciculations and finally by electromyography (EMG) of the affected muscles. First improvements occurred after the dental restorations. Two months after starting therapy with DMPS, the mercury level in the urine was increased (248.4 µg/g creatinine). After 1.5 years, EMG confirmed the absence of typical signs of ALS. In the course of 3 years, the patient recovered completely. Conclusions: The therapy described here is a promising approach to treating some kinds of motor neuron disease and merits further evaluation in rigorous trials.

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Schlüsselwörter
Amyotrophe Lateralsklerose · Progressive Muskelatrophie · Motorneuronerkrankung · Chelat-Therapie · Quecksilber · Schwermetalle

Zusammenfassung
Introduction

Amyotrophic lateral sclerosis (ALS) is a neurodegenerative disease characterized by selective motor neuron death. Patients develop a progressive muscle phenotype characterized by spasticity, hyperreflexia, fasciculations, muscle atrophy, and paralysis. Depending on the disease variant, upper or lower neurons are damaged, or both [1]. The paralysis progresses affecting more and more muscles and the patients finally die from asphyxia. The median survival time after onset of symptoms is 32 months [2, 3].

Despite considerable progress in understanding the cellular and molecular events in ALS [4], there is no generally accepted therapy besides riluzole, which may prolong survival by only 3 months [5]. Numerous new therapies are currently investigated [6], also including complementary medicine [7], and some of them may be promising. In the clinic of J.M., a plan of treating chronic diseases has been developed that involves eliminating risk factors, especially heavy metals, curing the sources of inflammation, and substituting with micronutrients and diets. Numerous patients have experienced considerable improvements. A case report of a successful treatment for secondary adrenal insufficiency with fibromyalgia has already been published [8]. Here, we report a case where progressive motor neuron disease (PMA), the variant of ALS involving only the lower motor neurons [9], was treated successfully.

Case Report

Presenting Concerns

In October 2012, a 49-year-old male patient (non-smoker, non-drinker, 178 cm, 77 kg) observed a weakness in his right arm following the restarting of martial arts after having paused for 2 years. In December 2012, he experienced additional weaknesses in the left and right shoulder and in the right thigh, and since then he noticed fasciculations in the upper extremities as well as more frequent urination.

Clinical Findings

After initial presentation at a resident neurologist, he was admitted in January 2013 to a neurological inpatient unit, and finally he presented in the clinic of J.M. in February 2013 (for a timeline, see table 1). The following findings were reported by the neurological inpatient unit. There was a slight paresis of the left arm, and the left upper arm was somewhat thinner than the right upper arm. In both arms and in both lower legs fasciculations were observed. The intensity decreased from proximal to distal and from left to right. In the pronator drift test, the left arm pronated. The muscle reflexes were weak but more pronounced on one side. Pyramidal signs were negative. The superficial sensibility was unaffected. Fasciculations were also seen in the examinations in the clinic of J.M. in February 2013, as well as weakness of muscles in the left and right shoulder, the right triceps, and the right thigh. Additional symptoms were diarrhea and sleeping disorders.

Disease History

The patient had received numerous vaccinations (table 1); no adverse reactions were reported. In 2004, the patient had suffered from severe meningomyeloencephalitis from a herpes zoster infection: two days after a hit in the neck during combatant sports, the disease started with paralysis of the bladder. Subsequently, the patient developed nausea, loss of vision, fever, somnolence, as well as paresthesia and paralysis of the whole body starting at the thorax level.

Table 1. Timeline

<table>
<thead>
<tr>
<th>Year</th>
<th>Diseases, diagnoses, interventions, important life events</th>
</tr>
</thead>
<tbody>
<tr>
<td>1965–1990</td>
<td>various vaccinations including tetanus, pertussis, polio, hepatitis A, diphtheria, cholera</td>
</tr>
<tr>
<td>1970–1985</td>
<td>dental caries, received 16 amalgam fillings</td>
</tr>
<tr>
<td>1999</td>
<td>removal of dental amalgam fillings without protection; replaced by denture of gold (5) and ceramics (8)</td>
</tr>
<tr>
<td>2003</td>
<td>vaccination: tetanus, polio, and diphtheria</td>
</tr>
<tr>
<td>2004</td>
<td>vaccination: hepatitis A</td>
</tr>
<tr>
<td>2004</td>
<td>sports injury: hit in the neck and subsequent meningomyeloencephalitis caused by herpes zoster, prolapsed cervical disk</td>
</tr>
<tr>
<td>2005</td>
<td>vaccination: tick-borne encephalitis</td>
</tr>
<tr>
<td>2008</td>
<td>got a tattoo (6 × 20 cm, lower arm)</td>
</tr>
<tr>
<td>2008</td>
<td>vaccination: tick-borne encephalitis, hepatitis A + B</td>
</tr>
<tr>
<td>2010–2011</td>
<td>divorce</td>
</tr>
<tr>
<td>10/2012</td>
<td>weakness in arms and legs, fasciculations, more frequent urination</td>
</tr>
<tr>
<td>12/2012</td>
<td>resident neurologist: transfer to neurological inpatient unit for further diagnosis</td>
</tr>
<tr>
<td>01/2013</td>
<td>neurological inpatient unit: diagnosis of PMA based on clinical findings, EMG, electroneurography, MRI, investigation of spinal fluid, blood parameters</td>
</tr>
<tr>
<td>02/2013</td>
<td>clinic of J.M.: further diagnoses; start of therapy with vitamins, micronutrients, and other supplements</td>
</tr>
<tr>
<td>03/2013</td>
<td>dental treatment: removal of metals, curing of osteitis</td>
</tr>
<tr>
<td>03/2013</td>
<td>first signs of improvement, increased strength in thigh</td>
</tr>
<tr>
<td>03/2013</td>
<td>start of chelation therapy</td>
</tr>
<tr>
<td>04/2013</td>
<td>start of psychotherapy</td>
</tr>
<tr>
<td>05/2013</td>
<td>removal of titanium screws in knee</td>
</tr>
<tr>
<td>09/2013</td>
<td>removal of tattoo</td>
</tr>
<tr>
<td>10/2014</td>
<td>absence of typical signs of motor neuron disease confirmed by resident neurologist by EMG</td>
</tr>
<tr>
<td>04/2017</td>
<td>further improvements and good health</td>
</tr>
</tbody>
</table>

EMG = Electromyography; PMA = progressive muscle atrophy; MRI = magnetic resonance imaging.
The patient could not walk any more, although some leg movements were possible. Later, he had feelings of heat in the back of his legs. Magnetic resonance imaging (MRI) showed several prolapsed cervical discs. Further examinations in a neurologic clinic showed nystagmus, indistinct articulation, highly increased immunoglobulin G (IgG) levels for herpes zoster in the serum, increased protein, IgG, lactate, and a number of lymphocytes in the cerebrospinal fluid. The patient received antiviral and antibiotic therapy. Within 6 weeks, the paralyses diminished gradually. The overall recovery took 3–4 years. With respect to the later diagnosis of ALS in 2012, it is remarkable that no findings were reported in the electromyography (EMG) and in the nerve conduction studies.

**Diagnostic Focus and Assessment**

In the neurological inpatient unit, the investigations focused on the possibility of a motor neuron disease, investigating the cervical spinal stenosis and addressing the meningomyeloencephalitis diagnosed in 2004. While the MRI scan of the brain showed no abnormalities, the spinal MRI scan showed degenerative changes, i.e. cervical spondylosis with multisegmental spinal stenosis without myelopathy. In the EMG, signs of acute and chronic denervation were found in several muscles:

- **Musculus (M.) masseter:** chronic denervation;
- **M. vastus medialis, right side:** acute and chronic denervation;
- **M. tibialis anterior, right side:** chronic denervation;
- **M. gastrocnemius caput lateralis, left side:** chronic denervation;
- **M. biceps brachialis, left side:** chronic denervation;
- **M. adductor digiti minimi, right side:** chronic denervation;
- **M. deltoideus, right side:** acute and chronic denervation.

Fasciculations were only detected in the arms and legs. The motor nerve conduction velocity of the ulnar nerve (Nervus (N.) ulnaris) was unchanged while the sensible conduction velocity was decreased on both sides, but to a higher degree at the left side. The motor-evoked potentials of the arms and legs were normal. No F-waves were found in investigations of the N. medianus and N. ulnaris. Electroneurographic examinations of the N. axillaris showed a reduction of the amplitude, which was more pronounced on the left side compared to the right side.

Total protein was slightly increased in the spinal liquor (81.8 mg/dl), resulting from an increase in albumin (54.8 mg/dl). Cell counts, glucose and lactate levels were within the normal limits. Intrathecal antibodies were not detected. Standard laboratory tests were without relevant findings. There were no antibodies to gangliosides in the serum. The creatine phosphokinase levels were unchanged. In the end, these findings led to the diagnosis of progressive muscle atrophy (PMA) [2]. Table 2 shows the rationale for the exclusion of relevant differential diagnoses.

In February 2013, just after the diagnosis of PMA, the patient presented in the clinic of J.M., where additional parameters in blood and urine were investigated. 25-Hydroxyvitamin D3 (14 µg/l, reference 30–60 µg/l), omega-3 index (4.44, reference >8), and creatinine in urine (0.28 g/l, reference 0.8–2.0) were decreased. Cystatin C (0.81 mg/l, reference 0.56–0.95 mg/l), however, was within the normal limits, indicating normal glomerular filtration. Borrelia-specific IgG and IgM were negative; a later lymphocyte transformation test for Lyme borreliosis was also negative.

Analysis of the history with respect to mercury exposure showed unprotected removal of 16 amalgam fillings in 1999. Exposure to mercury from the preservative thimerosal may have occurred by vaccinations and from the use of contact lens fluids. The analysis of metals in pubic hair, however, provided a mercury concentration within the normal limits and minor changes for copper and iron.

The status of the teeth in February 2013 was as follows: teeth 18, 16, 28, 38, 41, 46, 48 were missing, in the cavitation of the 2 missing teeth 16 and 46, osteonecrosis was observed. Teeth 14, 15, 17, 24–27, 37–35, 44, 45, and 47 had gold or ceramic denture. Three teeth with root canal fillings (25–27) showed apical osteitis.

**Therapeutic Focus and Assessment**

The therapy aimed at removing all possible sources of inflammation or chronic intoxication. For this purpose, 3 teeth were extracted. Instead, a removable prosthesis was incorporated. The osteitis in the regions of the 2 missing teeth was treated, and the metal denture in the remaining teeth was replaced by zirconium oxide denture. All dental procedures were made with proper safety measures to minimize the patient’s exposure to metals and other dental materials, dusts, and fine particles. A black tattoo was removed. Analysis of metals in pubic hair, however, provided a mercury concentration within the normal limits and minor changes for copper and iron.

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followed by sodium 2,3-dimercaptopropanesulfate (DMPS; 250 mg), together with potassium (6 mmol), magnesium (12 mmol), calcium (200 mg), and glutathione (GS; 1,800 mg). Finally, after the DMPS infusion, sodium selenite was i.v. injected separately. In addition to the i.v. infusion, DMPS (250 mg) was applied subcutaneously (s.c.) once per week. The treatment frequency was gradually reduced during therapy, resulting in 45 s.c. and 30 i.v. applications from March 26, 2013 until June 3, 2015. Until February 2, 2016, DMPS was applied orally 11 times (1 vial with 250 mg DMPS, mixed with 3 organic egg yolks, producing highly absorbable liposomal DMPS). Thus, overall, the patient received 86 DMPS applications.

In addition, the patient was advised to keep a vegetarian diet with a high proportion of raw, unprocessed food (60–70% of daily intake), also including wild herbs, and to reduce carbohydrate and especially gluten intake.

The patient’s compliance with this therapy has been excellent. Motivated by the continuous improvement of his health, he has been following the instructions up to now.

**Follow-up and Outcomes**

Several laboratory investigations were performed to follow the therapy. The most important results are provided here.

Metals in the urine were determined in spot urine samples at the start of the chelation therapy, and after 1 and 2 months. The patient was asked to control before i.v. infusion of DMPS. About 45 min after finishing the infusion, urine was collected. For mercury, the first 2 measurements (4.3 and 3.9 µg/g creatinine, respectively) were below the reference value of 50 µg/g creatinine for DMPS challenge. Finally, in the third measurement, 1 month later and after 7 DMPS infusions, there was a strong increase in mercury to 248.4 µg/g creatinine.

The high zinc values in the urine (3,130.6 to 6,581.8 µg/g creatinine, reference 2,000–9,000 µg/g creatinine) indicate that zinc was substituted successfully before and after the chelation therapy.

After the treatment of his teeth, already before the chelation therapy, the patient felt immediate relief. The muscular strength increased, which he recognized by improvements when climbing stairs. Figure 1 shows the course of the most prominent findings during the 3 years of treatment. With the exception of the left shoulder muscle, the weakness diminished within 4 months after treatment start. The general health improved; the patient took up jogging and went to a gym regularly. He gained muscle mass and body weight. His performance in sports became even better than before the diagnosis of PMA. After 1.5 years, a neurologist confirmed the absence of ALS by EMG of the affected muscles.

### Table 3. Daily dosages of orally applied vitamins, micronutrients, and other supplements

<table>
<thead>
<tr>
<th>Vitamins</th>
<th>Micronutrients</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>retinol</td>
<td>B</td>
</tr>
<tr>
<td>B₁</td>
<td>thiamine</td>
<td>C</td>
</tr>
<tr>
<td>B₂</td>
<td>riboflavin-5-phosphate</td>
<td>Cr</td>
</tr>
<tr>
<td>B₃</td>
<td>niacinamide</td>
<td>K</td>
</tr>
<tr>
<td>B₅</td>
<td>Ca-pantothenate</td>
<td>Mg</td>
</tr>
<tr>
<td>B₆</td>
<td>pyridoxal-5-phosphate</td>
<td>Mn</td>
</tr>
<tr>
<td>B₇</td>
<td>biotin</td>
<td>Mo</td>
</tr>
<tr>
<td>B₉</td>
<td>methyltetrahydrofolate, glucosamine salt</td>
<td>Se</td>
</tr>
<tr>
<td>B₁₂</td>
<td>adenosylcobalamin</td>
<td>Vn</td>
</tr>
<tr>
<td>C</td>
<td>ascorbic acid</td>
<td>Zn</td>
</tr>
<tr>
<td>D</td>
<td>cholecalciferol</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>α-tocopherol, all 8 isoforms</td>
<td></td>
</tr>
<tr>
<td>K₂</td>
<td>menaquinone 7</td>
<td></td>
</tr>
</tbody>
</table>

### Discussion

Comprehensive investigations led to the diagnosis of PMA based on:
- clinical findings (weakness and fasciculations) in 2 body regions (shoulder and lower legs);
- EMG findings of denervation in 2 body regions (arms and legs) as well as
- bulbar signs in EMG (denervation of m. masseter).

PMA is distinguished from ALS by a lack of effects on the upper motor neuron. The close relationship of the 2 diseases is, however, reflected by the fact that upper motor neuron findings often appear at later stages of PMA, and degeneration of upper motor neurons is also found in the majority of PMA patients if autopsy is performed. In addition, patients with a PMA phenotype carry pathogenic mutations known from ALS. Therefore, PMA is considered to be a variant of ALS [9].

When evaluating the success of the therapy, it is also important to rule out misdiagnosis, because similar diseases might be better treatable than ALS. As described above, the diagnostic process was thorough and several alternative diagnoses to motor neuron diseases can be excluded, as summarized in table 2. A finding that is not typical of ALS is a slightly increased quotient of albumin in the spinal fluid/serum of $11.2 \times 10^{-3}$. A range of $6.5 \times 10^{-3}$–$8 \times 10^{-3}$ is considered as normal at the age of the patient. For ALS patients, maximum values of $10 \times 10^{-3}$ have been reported [10]. As this is the only parameter changed in the spinal fluid, a few diagnoses besides ALS may account for this finding. One of them is cervical spinal stenosis. As the patient had cervical spinal stenosis, this may have caused the observed albumin increases in the spinal fluid [11]. In addition, a reduced sensory nerve conduction velocity is not typical of ALS. According to Kollewe and Petri [12], however, it does not contradict this diagnosis.

To allow a consistent evaluation, it would have been desirable if the hospital that had first diagnosed the motor neuron disease had examined the patient after the therapy. This option was proposed...
several times to the patient. However, for personal reasons (as the physician told him that he will die in 1–2 years, the patient fell into a deep depression and considered suicide), the patient refrained from returning to this hospital but chose to see the resident neurologist who had first sent him to the hospital. The resident neurologist registered the absence of motor neuron disease in his EMG examinations, which can be taken as confirmation of the successful therapy.

There is also the possibility of spontaneous healing of motor neuron disease. In fact, there are a few reports that ALS may be reversible, even without therapy [13–15]. The temporal association of the improvements with the therapy in the case of our patient, however, argues against spontaneous healing. In addition, several other ALS patients have improved considerably after therapy initiated by J.M. based on a similar protocol.

In conclusion, we are confident that the patient had indeed suffered from motor neuron disease and that his healing was a consequence of the therapy.

The patient received a chelation therapy, to remove amalgam or other heavy metals originating from an assumed previous exposure, although no residual amalgam was detected during the investigation of the teeth, and although the levels of mercury and other metals in the hair and after the first 2 DMPS challenges were within the normal reference values. According to the experience of J.M., a chelation therapy is already justified when exposure, e.g., from unprotected removal of dental amalgam, has been established in a patient’s history, even without measuring abnormal values through normal routes of human biomonitoring. This is backed by data showing that verified exposure to mercury can lead to neurological symptoms despite normal biomonitoring results [16, 17]. Furthermore, this approach is justified in hindsight by the fact that, finally, high mercury concentrations appeared in the urine of the patient during the chelation therapy, albeit with a delay of 2 months. The delay was probably due to an accumulation of mercury in deep compartments like the brain or the spine, where it is not readily accessible [18]. Mercury accumulates in interneurons and to a lesser degree in α-motoneurons, in amounts increasing with age. This may lead to motor neuron death and thus provides support to the view that exposure to mercury may be a contributing factor to ALS in susceptible individuals [19].

There are reports in the literature showing that chelation therapy is capable of reducing ALS or ALS-like symptoms after exposure to mercury [20], but there are also cases without success [21]. The chelation therapy applied here is different from earlier approaches. First, it is applied over a long period. Generally, with prolonged DMPS application, several peaks of mercury are observed in the urine in humans previously exposed to mercury [22], which is possibly due to the redistribution of mercury from deep compartments into tissues that are accessible to DMPS [23–26]. As it is known that mercury accumulates as inorganic mercury in the brain, it is important to cover these deep compartments by an appropriate therapy. The numerous applications were well tolerated by the patient, which is consistent with the low toxicity of DMPS [27].

In addition, the chelation therapy involves α-lipoic acid. α-Lipoic acid enters the brain and reverses the oxidant effects of mercury [28], but it is not capable of removing mercury from the brain [26]. As it also has chelating properties, it may contribute to the elimination of mercury from other compartments of the body. Finally, selenium plays an important role in the therapy. Selenium effectively binds to mercury and reduces its toxicity [29, 30]. Thus, any remaining mercury that may not be bound to DMPS can be efficiently inactivated.

Another factor that may have contributed to the therapy is the intensive dental treatment aiming at removing residual amalgam, other metals, and inflammation. No amalgam was detected, but metal linings were restored and the osteitis under 2 teeth of the patient was cured. Osteitis – also called fatty degenerative osteonecrosis of the jaw – is a frequent complication of high concentrations of amalgam in the oral cavity.

Fig. 1. Time course of improvement of symptoms during treatment. Scores were rated at 0–10, with 10 being the maximum; fasciculation and body weight were established independently or through measurement; all other variables were scored by the patient at every visit on a 10-point numerical rating scale.
crosis, chronic ischemic bone disease, neuralgia-inducing cavitation osteonecrosis, or just jawbone cavitation – is characterized by hollow cavitations with soft tissue that have undergone fatty dystrophic changes, and by delamination of the bony sheath of the inferior alveolar nerve [31]. It may produce facial pain but can also be present for years as an asymptomatic process. Dramatically increased levels of RANTES and fibroblast growth factor 2 (FGF-2) can be detected in the fatty tissue removed by surgery, but no elevations in cytokines associated with acute inflammation [32, 33]. RANTES is increased in the serum of patients with several chronic diseases, including ALS [34]. Surgical debridement of the tissue in the cavitations has led in several cases to an improvement of the neuralgic pain in the face [35], and also of immunological complaints, such as rheumatic, allergic, and other inflammatory diseases [33]. The fact that the patient felt immediate relief after treatment of his teeth even before the start of the chelation therapy points to a possible contribution of this treatment to healing. Furthermore, according to the experience of J.M., major improvements in the disease status of his patients are observed if teeth are cured at the start of the therapy, which involves – sometimes – radical eliminations of teeth.

Psychotherapy was initiated by the patient after the start of the therapy as a support for the emotional problems associated with his disease and its interpersonal consequences. In his own view, however, this was not the major causative factor for his improvement.

In conclusion, the therapy described here is a promising approach to treating some kinds of motor neuron disease. It should be evaluated more widely and rigorously.

Patient's Perspective

The patient noted down his experiences during the diagnosis and treatment of his disease; the text is publicly available [36].

Informed Consent

The patient consented to anonymous publication of his data, which is gratefully acknowledged by the authors.

Author Contributions

I.M. conducted the review of the case and wrote the manuscript. J.M. developed and conducted the therapy and organized a large part of the data collection. He also contributed to writing the paper and critical discussions. H.W. generated the idea for the study, developed the protocol, and partook in writing the paper and in critical discussions.

Disclosure Statement

None of the authors has any conflict of interest.

References