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RESPIRATORY OUTCOMES OF PATIENTS WITH ALS: AN ITALIAN NATIONWIDE SURVEY

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ABSTRACT (247)

Background. Despite recommendations, respiratory therapies still remain partially underutilized in ALS patients and different habits are described among different countries. The objective of our study was to evaluate attitudes and practices in Amyotrophic Lateral Sclerosis (ALS) in our country, in comparison with therapeutic intervention for Neuromuscular Diseases (NMDs) other than ALS.

Methods. A questionnaire on management approaches for ALS and NMDs was mailed to 178 Pneumological Units (PUs). PUs were classified into high versus low volume referring centers according to the number of ALS/NMD patients followed in the last 5 years.

Results. 76 PUs (43%) responded after having an historical sample size of 1772 ALS patients and 1490 NMDs patients. Difficulty clearing respiratory secretions and disturbed sleep were the main reasons the patients with ALS were referred to PUs. Vital capacity in a sitting position and arterial blood gases were measured regularly, while respiratory muscle function and cough ability were routinely assessed in over 85% of the PUs, (mainly in high referring centers) and 94% of PUs had access to noninvasive ventilation (NIV). Treatment approach in NMDs was similar to that of ALS, except for administration of tracheostomy, which was less frequently performed in NMDs. A multidisciplinary team approach to care was employed in approximately 90% of PUs. Approximately a third of PUs accessed palliative care services.

Conclusions. Combined pulmonary function evaluation, long-term NIV and assisted coughing have become usual practices for ALS patients. Care habits for ALS do not significantly differ from approach to other NMDs.

Keywords: Amyotrophic Lateral Sclerosis – Respiratory Failure – Noninvasive Ventilation

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INTRODUCTION (3238)

Amyotrophic lateral sclerosis (ALS), also called Lou Gherig's Disease is an incurable and rapidly progressive neurodegenerative disease involving limbs and bulbar musculature. It is the most common form of motor neuron disease, affecting approximately 1.2-1.8/100,000 individuals. Clinically, ALS is characterized by progressive muscular weakness leading to loss of the ability to move and speak in almost all patients. Death occurs between three and five years from diagnosis. In the majority of the cases intellect and awareness remain essentially unchanged, although mild to severe cognitive impairment has been reported in the literature[1,2].

Patients with ALS usually die from acute respiratory failure (ARF) either due to diaphragm weakness, ineffective cough with difficulty clearing respiratory secretions and inability to handle oropharyngeal secretions, or chronic progressive respiratory failure (CRF) which may be preceded by sleep-disordered breathing caused by nocturnal hypoventilation[3-5]. Nevertheless, the treatment of respiratory complications in ALS patients was historically considered controversial due to the lack of a truly effective therapeutic approach and the fact that quality of life (QoL) at an advanced stage was judged to be unduly compromised.

In addition, there is the consideration that the patient's dependence on home ventilatory support incurs a significant physical and economic burden on family and caregivers. This also raised the issue of social desirability of managing ALS individuals at a far advanced stage of the disease[6-8]. However, in recent years, randomized controlled trials have indicated that therapy with long-term noninvasive ventilation (NIV) improves both survival and QoL[9-11]. It has been reported that patients with ALS improved survival after tracheostomy for acute respiratory failure (ARF)[12,13]. As a result, a growing number of patients with ALS, who have developed severe ventilator impairment, are being successfully treated. In keeping with this changing approach, evidence based practice guidelines recommend management of respiratory insufficiency with NIV as well as consideration of insufflation/exsufflation to improve clearance of airway secretions and

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administration of tracheostomy invasive ventilation (TIV) to preserve QoL in patients who accept long-term ventilator support[14,15]. Despite these recommendations, respiratory therapies still remain partially underutilized in ALS patients and marked variation has been reported in the use of ventilatory support within and between different countries, with significant differences according to the referral center[15-18]. In this regard, NIV is significantly underutilized in the USA, where only 21% of the 5,600 patients from the ALS Care Database study received noninvasive ventilator support[15].

Based on these considerations, we conducted an investigation on several Italian Pneumological Units (PUs) aimed at characterizing their diagnostic approach and management of respiratory complications in individuals with ALS. In addition, we compared the attitudes, practices and therapeutic interventions in the treatment of ALS patients to those for Neuromuscular Diseases (NMDs) other than ALS, whose standard of care has been accepted widely over a longer period of time.

MATERIAL AND METHODS

All PUs potentially involved in the respiratory care of patients with ALS and/or other NMDs were identified through the registry of the Italian Association of Hospital Pulmonologists (AIPO). A questionnaire was developed by the co-authors in line with previous similar experience conducted in Europe[19] and sent to the AIPO Intensive Care and Rehabilitation Group Physicians for comments and suggestions. The questionnaire was sent to all PUs in September 2011. The questionnaire was formally reviewed and approved by the local committee of the Foundation Salvatore Maugeri IRCCS Lumezzane (Brescia, Italy). The survey included 27 questions assessing the following aspects:

- characteristics of the PUs (institution type, health resources and number of patients

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followed up over the past five years);

- clinical and pulmonary function data collected on the first respiratory visit (in particular, difficulty in clearing respiratory secretions was defined as the occurrence of frequent respiratory tract infection, crisis of asphyxia and/or "bubbly" breathing);
- parameters used as bad prognostic indicators;
- timing and modalities of follow-up;
- treatment strategies and multidisciplinary approach (physicians were invited to select an option only when routinely prescribed);
- caregiver identification and education;
- use of palliative/end of life care plan.

Different types of questions were asked, including dichotomous YES/NO questions, simple and multiple choice questions. The questionnaire was administered on-line and was filled by participants by connecting to a specific form on AIPO website. Quantitative parameters were described as mean±SD or median with the interquartile range (IQR), depending upon the normality of distribution. Qualitative parameters were described as numbers (%).

A statistical analysis by one sample proportion test was performed to detect significant variations between management of ALS and NMDs and between centers with high and low expertise; level of clinical expertise was defined by the number of patients with ALS and other NMDs cared for at the centre over the past 5 years (for high expertise, at least 20 patients were required for each disease category). Analysis was performed on data submitted from the 74 PUs completing the questionnaire. A two-sided p value < 0.05 was considered significant. Analyses were performed by statistics software (STATA 11.1, Texas USA).

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RESULTS

A total of 178 PUs were identified by the AIPO registry; 76 out of 178 (42.7%) answered the survey and 74 questionnaires and 2 reply cards were completed. Table 1 shows the number of PUs who responded, classified according to institution type and number of patients with ALS and NMDs followed over the past 5 year. The total number of patients with ALS and other NMDs under care during the last 5 years was 1772 and 1490, respectively.

Table 2 lists the symptoms resulting in the initial referral to a PU, pulmonary function tests (PFTs) performed at the initial evaluation and parameters used as prognostic indicators of respiratory problems. Difficulty in clearing respiratory secretions was observed far more frequently in ALS patients than in patients with other NMDs. Dyspnea on exertion was common both in patients with ALS and NMDs. Cognitive impairment, irritability, nocturnal awakenings, excessive daytime sleepiness, difficulty in concentrating and disturbed sleep were more common in patients with NMDs. The proportion of responding PUs that reported to assess respiratory function at the first referral was near 100%; whereas slow sitting vital capacity (VC) and arterial blood gases (ABG) were routinely measured, nocturnal oxymetry, maximal inspiratory and expiratory pressure (MIP, MEP) and maximal sniff nasal pressure (SNP) were less frequently evaluated. Abnormalities of the PaO_2 and $PaCO_2$, use of MV >18h/day and physician indication for TIV were considered bad prognostic indicators.

Serial measurements of VC and ABG were regularly performed during the follow-up period in the majority of the PUs (Figure 1). Nocturnal oxymetry, cardio-respiratory monitoring and polysomnography were considered necessary only if patients were symptomatic. Overall, 70% of PUs used nocturnal respiratory studies to assess sleep disordered breathing during follow-up. Frequency of follow-up visits was individualized in most centers, according to disease stage and patient's need. A lower proportion of centers assessed respiratory status at a fixed time interval (every three or six months). In 13.2% of cases, a follow-up visit was not scheduled. Modality of

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follow-up included: dedicated outpatient office (65.4% of centers), hospital admission for patients' special needs, including prescription of new devices, education reinforcement, and resetting of the ventilator (51.9%), home visits (28.8%), and a structured program of telesurveillance (11.5%). When compared to patients with NMD, VC and MIP/MEP at the initial visit were more frequently evaluated in ALS individuals ($p<0.03$ and $p<0.0011$, respectively). During the follow-up period, ABG was more frequently measured in ALS patients ($p<0.006$) (Figure 1).

Data on therapeutic interventions and parameters used as indicators to start NIV or initiate TIV and the respiratory care setting for the management of acute exacerbation are reported in Table 3. Only 6% of the responding PUs indicated that they had no access to NIV treatment and 12% did not routinely administer manual or mechanical cough assistance. Daytime hypercapnia, sleep-related hypoxemia, and a decrease of VC <50% predicted were the parameters most commonly followed to initiate NIV. The symptoms most likely to trigger NIV prescription were dyspnea on exertion, fatigue and orthopnea. Both ALS and other NMDs patients were considered eligible for tracheostomy when they demonstrated an inability to be completely weaned from intubation, or the need for NIV > 18h/day, or severe swallowing impairment. Only 9.6% of responding PUs had never initiated TIV to their patients. Acute respiratory problems were more frequently managed in a specialized Respiratory Intensive Care Unit (RICU). However, a significant proportion of ALS patients were treated during respiratory exacerbation in medical units not equipped with NIV.

A multidisciplinary team approach to care of patients with ALS was employed in approximately 90% of PUs, based on close cooperation of pulmonologists with neurologists (88.5%), physiatrists (57.7%), psychologists (38.5%) and physiotherapists (76.9%). Notably, collaboration with neurologists was defined as excellent or good in 51.9% of cases to such an extent that 48.6% of pulmonologists had developed an integrated care protocol. Also, communication between neurologists and pulmonologists was significantly less satisfying in low referring centers. Family caregivers were identified by 100% of PUs when starting a patient on home mechanical ventilation (HMV). In addition, the total amount of responding PUs regularly provided a structured

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training program, including family and caregiver education. Only 34.6% of the PUs accessed palliative care services at the end of ALS patient's life, and a similar proportion was referred for NMDs patients (28.1%). Advanced directives, concerning which circumstances the patients would desire withdrawal from MV were adopted in 32.1% and 29.4% of PUs, respectively for patients with ALS and NMD.

Significant differences in care practice between high and low referring centers are reported in Table 4. High referring centers assessed respiratory muscle function and cough ability more accurately and were more likely to consider intervention with NIV when respiratory muscles strength was reduced. In addition, the specialized RICUs were more commonly trained and equipped to treat patients during acute exacerbation. High referring centers also offered structured follow up programs, reported better collaboration between pulmonologists and neurologists and more frequently used palliative measures at the final stages of the disease. In contrast, low referring centers had higher tracheostomy rates for those patients with ALS who were difficult to wean from intubation.

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DISCUSSION

In recent years, the approach to the care of people with ALS who have developed respiratory failure has been clearly modified and the treatment of respiratory complications has been encouraged, due to the development of new instruments, such as NIV and cough assistance[20,21]. However, despite this substantial change in clinical practice, management of ALS-related respiratory complications still remains a subject of ethical controversy.

We performed the first Italian national survey of respiratory care in individuals with ALS, which provided information on 76 PUs following 1772 patients. It should be noted that replies were received only from 42.7% of PUs and there is no information on the number of patients managed by the non-responders. However, this number is likely to be small, since all major Italian ALS reference centers answered our questionnaire. Thus, we believe that our data may represent a comprehensive review of diagnostic and therapeutic patterns in Italy. On the other hand, this low response rate underlines the importance of disseminating critical guidelines and ensuring appropriate management of ALS patients to those smaller centers who are likely to be less familiar with current recommendations.

The PUs routinely cared for ALS patients, in which the initial referral was usually due to difficulty clearing respiratory secretions because of the inability to effectively cough or swallow. Clearing airway secretions is often a major problem for ALS patients exacerbated by the inability to swallow saliva or food without aspiration and was a frequent reason why physicians began TIV.

Less than 60% of Italian PUs reported regular measurements of Peak Cough Expiratory Flow (PCEF), which is a reliable parameter of cough ability and allows simple assessment and monitoring of its evolution[22]. Low referring centers were less familiar with the use of PCEF guidelines. Another symptom of respiratory compromise is progressive CO_2 retention. This can be subtle and represents an underestimated manifestation of respiratory impairment[23-25]. Pulmonary function testing at the initial visit routinely included sitting VC, MIP, MEP, SNP and measurement

of daytime ABG. The combination of respiratory muscle strength and pulmonary function measures for detection of early respiratory involvement in ALS patients can be more effective than reliance on one particular test[26,27]. It is noteworthy that pulmonary function data on the first visit may have underestimated the frequency of subsequent measurements of the MIPs/MEPs. If centers would perform these tests when baseline FVC becomes abnormal, this would avoid unnecessary testing in patients with a normal FVC. Nocturnal oxymetry was performed in about 90% of PUs during the initial evaluation, based on the knowledge that alveolar hypoventilation may occur during the hours of sleep before daytime symptoms become apparent. Thus, sleep hypoxemia may be one of the earliest indicators of respiratory insufficiency in ALS individuals[28]. It is noteworthy that recent guidelines have concluded that nocturnal oxymetry alone is an acceptable method of screening for hypoventilation in asymptomatic individuals with NMD, assuming that clinically significant hypoventilation of neuromuscular origin is unlikely to occur in the absence of desaturation below 93%[29]. Following initial nocturnal oxygen saturation assessment, most PUs performed a new assessment of sleep-related hypoventilation only if the onset of sleep was associated with symptoms, consistent with previous clinical practice recommendations[16].

In comparison with the first visit of patients suffering from NMDs other than ALS, our data indicated that the inability to cough was less frequent and that respiratory muscle function was likely to be less accurately assessed than in individuals with ALS. According to current guidelines, the management of respiratory insufficiency in ALS patients should include the administration of NIV as a primary treatment modality, based on the evidence of improved survival, QoL, symptoms, and health economic evaluation1[11,30]. For this reason, criteria have been proposed as indication for starting ventilatory treatment[14,31]. In regard to use of assisted ventilation, the main finding of our survey is that domiciliary NIV is currently prescribed by nearly all the PUs surveyed and that criteria commonly followed in the decision to initiate long-term NIV are: daytime hypercapnia (in 89% of units), sleep-related hypoxemia (in 85% of units) and sitting VC below 50% (in 67% of units). Although these criteria are in keeping with current consensus recommendations, NIV should

be considered at the earliest sign of nocturnal hypoventilation or respiratory insufficiency[14]. It is noteworthy, however, that more than one third of the centers considered patients' symptoms as secondary importance for indicators in starting NIV. This attitude is different from that of U.K. and Canadian physicians, asserting that patient symptoms are of primary importance for initiating NIV. Unless patients are motivated by the desire for symptom relief, they are unlikely to adhere to a noninvasive ventilatory regimen[17,18,32]. The transition to TIV in ALS patients, when bulbar impairment becomes severe, varies widely in countries, going from 1.4%-15% of referring centers in the United States to the majority of ALS patients in Japan[33,34]. Our results indicate that only 10% of Italian pulmonologists intentionally decide not to initiate TIV in ALS patients and 17% in NMD patients. The Italian pulmonologists recommend TIV if one of the following conditions is present: (a) patient intubated and unweanable from invasive mechanical ventilation; (b) patient using NIV for > 18 h/day, even without severe bulbar impairment (c) poor NIV tolerance (d) severe bulbar symptoms. Factors promoting the use of TIV include a late diagnosis of respiratory complications, suboptimal follow-up, and views on withholding ventilatory support. The use of the "Do Not Intubate-Do Not Resuscitate" code on individuals with end-stage respiratory disorder is less common among Italian pulmunologists, in comparison with other countries[35]. Only 32.1% of PUs discussed end-of-life issues and obtained advanced directives from their patients concerning life-support. This reveals that not enough effort is being made to educate ALS patients on breathing support options, if they desire to prolong their life and still continue to stay active socially. The more common use of TIV in Italy could reflect the greater availability of home care resources in Italy. In fact, respiratory home care is provided at no cost by the Italian National Health System[36]. By comparing ventilator assistance in ALS to other NMDs, our findings suggest that treatment approach is very similar in both conditions. The only differences were: (a) sleep-hypoxemia was considered a stronger indication for NIV in NMDs; and (b) TIV was more commonly used in ALS than other NMDs. Limiting the use of TIV in patients with a not rapidly progressive NMD is in accordance with the expert opinion indicating that tracheostomy tubes are only needed for those

individuals showing severe loss of bulbar muscle control and the inability to protect the airway from aspiration[37,38]. Based on our data, ~~continuous~~ 24 Hours NIV with mouthpiece ventilation in patients with preserved bulbar function is not considered as a viable option for totally ventilator-dependent individuals, probably due to inadequate team experience. Our survey shows evidence of a close cooperation between pulmonologists, neurologists and physiatrists. This is in line with a number of studies indicating the importance of a multidisciplinary approach aimed at assisting ALS patients with decision-making throughout the disease process about various care options[39,40]. Finally, the outcome of our questionnaire suggests that practice recommendations for the care of ALS patients are more closely followed by highly specialized centers compared to less experienced clinics. The high referral centers were more likely to accurately assess respiratory muscle function, both at the initial visit and during follow-up, with over 90% of clinics routinely measuring MIP, MEP and PCEF, and providing optimal ventilatory management. This includes limiting the use of TIV and following advanced directives. Discrepancy in the approach to monitoring and managing pulmonary function between high and low volume referral centers has been reported also by other authors, concluding that NIV represents an increasingly utilized option for the treatment of respiratory disturbances and has favorable effects on survival among patients followed by dedicated, high experienced tertiary ALS centers[41].

Some limitations of our study: a) there is a lack of information on excessive oral secretions or saliva as an airway problem and on the use of oropharyngeal suctioning for upper airway/oral secretions. This may have limited the ability to differentiate between bronchial and oral secretions, considering that responders of the questionnaire may not have identified this difference and that oral secretions continue to increase in bulbar patients and are ultimately a key problem in tolerating NIV b) survival of the patients was not determined. Survival may be an indicator of optimal use of NIV and level of respiratory care. However, evaluating the patients' survival outcomes was not included in the purpose of our survey, which was essentially dedicated to organizational interventions c) the

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definition of high clinical expertise by the amount of at least 20 patients cared for over the past 5 years was arbitrary, although related to the average number of patients followed by all PUs.

Nevertheless, we conclude that combined pulmonary function evaluation, long-term NIV and assisted coughing techniques have become the usual care for ALS individuals in Italy. In addition, TIV, following a respiratory crisis is regarded as a viable option in most cases, suggesting a high rate of complications and/or failed use of NIV. Moreover, provision of information on respiratory complications and end of life decisions is still insufficient and needs to be improved, so that patients and caregivers can be more active participants in disease management. The treatment strategy for ALS patients does not significantly differ from care for individuals with other NMDs, except for more frequent airway management. Finally, further investigation on reasons leading to emergency hospitalizations and unplanned tracheostomy are warranted.

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LEGEND

Figure 1: Frequency of Pulmonary Function Testing during follow-up period for Amyotrophic Lateral Sclerosis (grey bars) and Neuro-Muscular Disease (black bars) patients. Statistically significance is intended as follows: §= $p<0.03$; += $p<0.0057$; @= $p<0.0011$

ABG indicates Arterial Blood Gases; ALS, Amyotrophic Lateral Sclerosis; CRM, Cardio-Respiratory Monitoring; MIP-MEP, Maximal Inspiratory and Expiratory Pressure; NMD, Neuro-Muscular Disease; VC, Vital capacity

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TABLE 1. MAIN CHARACTERISTICS OF PULMONARY UNITS AND PATIENTS

PULMONARY UNITS	
PUs invited to participate in the survey, n	178
PUs who answered the survey , n (%)	76 (42.7)
Institution type	
University Hospital, n (%)	6 (7.9)
Acute Care Non-University Hospital, n (%)	61 (80.3)
Rehabilitation Hospital, n (%)	9 (11.8)
Health resources	
Hospital beds per unit, n (mean±SD)	20±14
Level of clinical experience	
Patients with NMD/ALS under care during the last 5 yrs, %	
• 0	1.9
• 1-5	11.1
• >5	3.7
• >10	29.6
• >20	53.7
PATIENTS	
ALS patients, n	1772
Mean duration of follow-up since diagnosis, months	37±12
Total patients with other NMDs, n	1490
Type of NMDs, n	
▪ Duchenne muscular dystrophy	1043
▪ Type I SMA	45
▪ Limb girdle MD 2C, 2D, 2F, 2I	25
▪ Nemaline myopathy	10
▪ Acid maltase deficiency	98
▪ Congenital myasthenia	65
▪ Congenital myotonic dystrophy	204
Mean duration of follow-up since diagnosis, months	108±24

ALS indicates Amyotrophic Lateral Sclerosis; NMD, Neuro-Muscular Disease; PUs, Pulmonary Units; SD, Standard Deviation; SMA, Spinal Muscular Atrophy

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TABLE 2. CLINICAL PRESENTATION, PULMONARY FUNCTION TEST PERFORMED AT THE INITIAL EVALUATION AND PARAMETERS CONSIDERED AS BAD PROGNOSTIC INDICATORS

	ALS	NMD	P-value
Symptoms resulting in the initial referral to PU, %			
Difficulty clearing respiratory secretions	77.4	6	0.0001
Dyspnoea on exertion	77.4	68.9	NS
Disturbed sleep	58.5	83.6	0.00001
Extreme fatigue	52.8	59	NS
Nocturnal awakenings	13.2	32.8	0.0000
Irritability	9.4	19.7	0.0021
Excessive daytime sleepiness	9.4	19.7	0.0021
Difficulty in concentrating	9.4	21.3	0.0004
Impaired cognition	1.8	24.6	0.00018
Pulmonary function test performed at the initial evaluation, %			
VC sitting	98.1	91.9	0.001
Blood Gas Analysis	98.1	95.2	NS
Nocturnal oximetry	88.7	83.9	NS
MIP/MEP	86.8	79	0.044
CRM/Polysomnography	64.2	74.2	NS
PCEF	56.6	58.1	NS
TLC and IC	54.7	54.8	NS
VC lying	47.2	56.5	NS
Sniff Inspiratory Pressure	15.1	17.7	NS
Parameters used as bad prognostic indicators, %			
Indication for tracheotomy	64	53	0.0457
Blood gases abnormalities	51	40	NS
Need for NIV	42	43	NS
Use of MV >18h/day	35	45	NS
Swallowing ability	28	32	NS
VC seated <50%	27	22	NS
Night-time spent at SaO_2 <90% >30% of the recorded time	25	20	NS
Loss of VC from sitting >25%	21	22	NS
PCEF<180L/min	21	22	NS
MIP<60% prd /MEP<60% predicted	20	22	NS
Pneumonia/atelectasis episodes	17	16	NS
Need for cough assistance	16	15	NS
Exacerbations with need for antibiotic therapy	9	7	NS
Apnea-hypopnea index > 15/hrs	9	4	NS
Speech ability	8	8	NS

Data were analyzed in the 74 Pus who completed the questionnaire. ALS indicates Amyotrophic Lateral Sclerosis; CRM, Cardio-Respiratory Monitoring; MIP-MEP, Maximal Inspiratory and Expiratory Pressure; MV, Mechanical Ventilation; NIV, Non-Invasive Ventilation; NMD, Neuro-Muscular Disease; PCEF, Peak Expiratory Flow During Cough; SaO_2, Oxygen Saturation; TLC, total lung capacity; IC, inspiratory capacity; VC, Vital Capacity

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TABLE 3. TREATMENT OPTIONS, PARAMETERS USED AS AN INDICATOR TO START NON-INVASIVE VENTILATION, PROVISION OF TRACHEOSTOMY AND SETTING FOR THE MANAGEMENT OF ACUTE EXACERBATION

	ALS	NMD	P-value
Therapeutic intervention, %			
Long-Term NIV	94.2	96.5	NS
Manual and/or mechanical cough assistance	88.5	84.2	NS
Artificial Nutritional	73.1	68.4	NS
Ventilatory muscles training	26.9	36.6	NS
Physical therapy	13.5	28.1	0.0002
Palliative drugs	0	1.8	0.001
Indicators to start NIV, %			
$PaCO_2$>45 mm Hg	88.5	93	NS
Sleep-related hypoxemia	84.6	94.7	0.0146
Sitting VC <50%	67.3	64.9	NS
Symptoms (dyspnoea on exertion, orthopnoea)	61.5	52.6	NS
MIP/MEP <60% predicted	53.8	47.4	NS
Provision of MV via tracheostomy, %			
Inability to be weaned from intubation	82.7	80.7	NS
Need for NIV >18 h/day, also without bulbar impairment	67.3	50.9	0.0023
Severe swallowing disturbances	32.7	26.3	NS
Never provided	9.6	17.5	0.00001
Acute respiratory care setting, %			
Specialised RICU	50	59	NS
Medical unit equipped with NIV	32	25.3	0.01
Medical unit not equipped with NIV	16	14	NS
Home	2	1.7	NS

ALS indicates Amyotrophic Lateral Sclerosis; ARF, Acute Respiratory Failure; MIP-MEP, Maximal Inspiratory and Expiratory Pressure; MV, Mechanical Ventilation; NIV, Non-Invasive Ventilation; NMD, Neuro-Muscular Disease; RICU, Respiratory Intensive Care Unit; VC, Vital Capacity

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TABLE 4. DIFFERENCES IN PRATICE BETWEEN HIGH AND LOW REFERRING CENTRES WHO COMPLETED THE QUESTIONNAIRE

	High referring Centers (n= 41)	Low referring Centers (n= 33)	P-value
Pulmonary function test performed at the initial evaluation, %			
MIP/MEP	93	55	0.03
PCEF	87	40	0.03
Indicators to start NIV, %			
MIP/MEP <60% predicted	70	45	0.04
Provision of MV via tracheostomy, %			
Inability to be weaned from intubation	45	70	0.04
Acute respiratory care setting, %			
Specialised RICU	78	45	0.03
Provision of a follow-up visit schedule, %	75	40	0.03
Adoption of a protocol for advance directives, %	70	25	0.03
Excellent or good collaboration with neurologists, %	45	23	0.04

MIP-MEP indicates Maximal Inspiratory and Expiratory Pressure; MV, Mechanical Ventilation; NIV, Non-Invasive Ventilation; NMD, Neuro-Muscular Disease; PCEF, Peak Expiratory Flow During Cough; RICU, Respiratory Intensive Care Unit; VC, Vital Capacity

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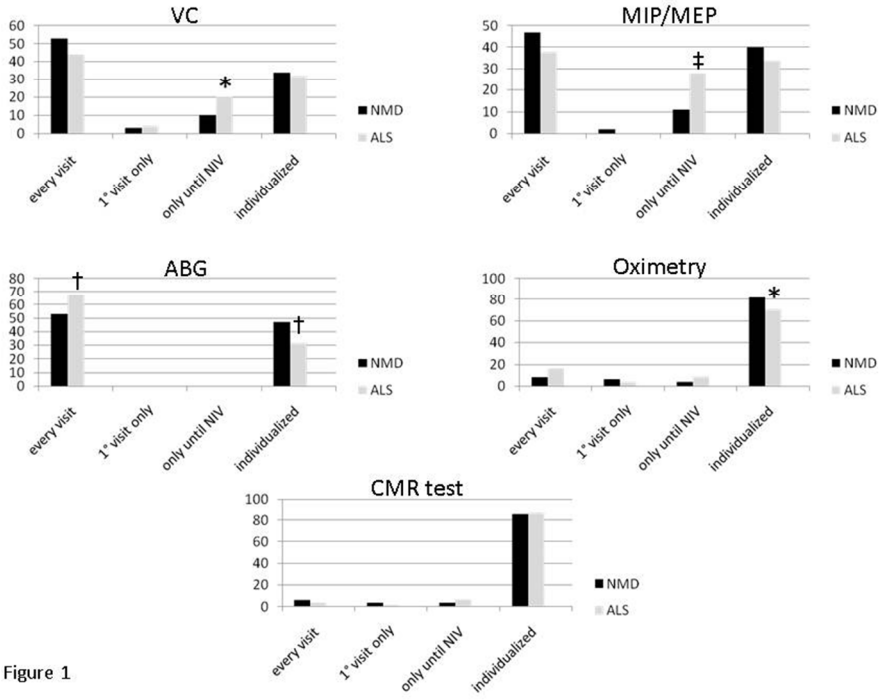

Figure 1

254x190mm (96 x 96 DPI)