Traccia orale #1

1. Caratteristiche e utilizzo della TMS ripetitiva.
2. Descrivere le caratteristiche ambientali ottimali di un laboratorio per registrazioni TMS-EEG
3. Aspetti etici e gestione del trattamento dati personali in un laboratorio TMS
4. Il candidato descriva le funzioni del rettore
5. Discussione dell'elaborato scritto

Esercizio Excel: fare una media di una serie di valori

Traccia orale #2

1. Qual è la differenza tra stimolazione magnetica (TMS) e stimolazione elettrica transcranica (tDCS/tACS)?
2. Aspetti etici di sicurezza e gestione delle emergenza medica in un laboratorio TMS.
3. Gestione degli acquisti in un laboratorio TBS: Consumabili e attrezzature.
4. Il candidato descriva le funzioni del senato accademico
5. Discussione dell'elaborato scritto

Esercizio Excel: rappresentare con un grafico a linee una serie di valori

Traccia orale #3

1. Che cos'è la soglia motoria e qual è il suo utilizzo?
2. Discutere come regolamentare l'uso del laboratorio con diversi protocolli sperimentali in relazione ai limiti di sicurezza e in rapporto con il comitato etico locale.
3. Come si gestiscono le procedure di acquisto di attrezzature di scale differenti di costo (ad esempio una bobina del costo di 3000 euro, uno stimolatore TMS del costo di 60.000 euro o di un magnetoencefalografo da 2.000.000 euro)
4. Il candidato descriva le funzioni del consiglio di amministrazione dell'università.
5. Discussione dell'elaborato scritto

Esercizio Excel: calcolare la deviazione standard i un campione di valori.

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7.3. Who should do TMS . . . 2032
7.3.1. Credentials and team . . . 2032
7.3.2. Training . . . 2033
7.4. Contraindications and precautions . . . 2033
7.5. A screening standard questionnaire for rTMS candidates . . . 2033
Appendix A. Supplementary data . . . 2034
References . . . 2034

1. Introduction

Transcranial magnetic stimulation (TMS) is a neurostimulation and neuromodulation technique, based on the principle of electromagnetic induction of an electric field in the brain. This field can be of sufficient magnitude and density to depolarize neurons, and when TMS pulses are applied repetitively they can modulate cortical excitability, decreasing or increasing it, depending on the parameters of stimulation, even beyond the duration of the train of stimulation. This has behavioral consequences and therapeutic potential.

The last decade has seen a rapid increase in the applications of TMS to study cognition, brain-behavior relations and the pathophysiology of various neurologic and psychiatric disorders (Wassermannn and Lisanby, 2001; Kobayashi and Pascual-Leone, 2003; Gershon et al., 2003; Tassinari et al., 2003; Rossi and Rossini, 2004; Leafaucheur, 2004; Hoffman et al., 2005; Couturier, 2005; Fregni et al., 2005a,b; Hallett, 2007; George et al., 2007; Málly and Stone, 2007; Rossini and Rossi, 2007; Devlin and Watkins, 2007; Ridding and Rothwell, 2007). In addition, evidence has accumulated that demonstrates that TMS provides a valuable tool for *interventional neurophysiology applications*, modulating brain activity in a specific, distributed, cortico-subcortical network so as to induce controlled and controllable manipulations in behavior.

Repetitive transcranial magnetic stimulation (rTMS) has been found to be a promising noninvasive treatment for a variety of neuropsychiatric conditions (Devlin and Watkins, 2007; George et al., 2007; Aleman et al., 2007; Fregni and Pascual-Leone, 2007), and the number of applications continues to increase with a large number of ongoing clinical trials in a variety of diseases. Therapeutic utility of TMS has been claimed in the literature for psychiatric disorders, such as depression, acute mania, bipolar disorders, panic, hallucinations, obsessions/compulsions, schizophrenia, catatonia, post-traumatic stress disorder, or drug craving; neurologic diseases such as Parkinson's disease, dystonia, tics, stuttering, tinnitus, spasticity, or epilepsy; rehabilitation of aphasia or of hand function after stroke; and pain syndromes, such as neuropathic pain, visceral pain or migraine. A large industry-sponsored trial (O'Reardon et al., 2007) and a multi-center trial in Germany (Herwig et al., 2007) of rTMS in medication of refractory depression have been completed, and other appropriately controlled and sufficiently powered clinical trials of TMS are ongoing.

Most claims of therapeutic utility of TMS across conditions need further support and evidence-based clinical trial data, but the potential clinical significance is huge, affecting a large number of patients with debilitating conditions. A number of clinics have been set up worldwide offering TMS for treatment of various diseases, and rTMS is already approved by some countries for treatment of medication-refractory depression (i.e., Canada and Israel). In October 2008, a specific rTMS device was approved by the Food and Drug Administration in the United States for the treatment of patients with medication-refractory unipolar depression who have failed one good (but not more than one) pharmacological trial. It is reasonable to expect that the use of rTMS and its penetrance in the medical community will continue to increase across different medical specialties.

The number of laboratories using TMS for therapeutic or neuroscientific purposes, and consequently the number of healthy individuals and patients with various neurological or psychiatric diseases studied worldwide, has been increasing yearly for the past 20 years (Fig. 1). A further increase in the wide-spread use of TMS in medical therapeutic applications and research is expected. This makes the need for clear and updated safety guidelines and recommendations of proper practice of application critical.

Current safety precautions and practice recommendations remain guided by the consensus conference held at the National Institutes of Health in June 1996 and summarized in Clinical Neurophysiology (Wassermannn, 1998). These recommendations were adopted with minor modifications by the International Federation for Clinical Neurophysiology (Hallett et al., 1999). Ethical considerations on the application of TMS to health and disease were initially dealt with by Green et al. (1997) during the early stages of rTMS testing, and more recently have been addressed by several publications (Wolpe, 2002; Mashour et al., 2005; Illes et al., 2006; Steven and Pascual-Leone, 2006). However, as previously mentioned, the use of TMS has grown dramatically in the past decade, new protocols of TMS have been developed, changes in the devices have been implemented, TMS is being increasingly combined with other brain imaging and neurophysiologic techniques including fMRI and EEG, and a growing number of subjects and patients are being studied with expanding numbers of longer stimulation sessions.

The safety of TMS continues to be supported by recent meta-analyses of the published literature (see Machii et al., 2006; Loo et al., 2008; Janicak et al., 2008), yet there is a clear need to revisit the safety guidelines, update the recommendations of practice, and

Fig. 1. Number of published papers per/year on Transcranial Magnetic Stimulation. Medline search updated to December 2008. Key words used are "Transcranial magnetic stimulation" (left bars) and "repetitive TMS" (right bars).