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Review

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Robotics in Neurorehabilitation: is the mainstream changing?

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Introduction

The proposal and availability of robotic treatment (RT) in any kind of neurorehabilitation (NR) treatments is increasing and in recent various studies showed improving results in patients, in particular after stroke (1).

It is the same situation regarding other new tecnologies (NT) such as assistive technologies, telerehabilitation, virtual reality and brain stimulation techniques. There is a great need of more specific studies concerning the effective interaction between RT and humans. The aim is to better define both interaction with humans facing impairment and consequences on the activity of professionals, with regards to treatment planning, assessment, and skill developing.

Main topics are: measurement means, direct and indirect costs, education not only for trained professionals, acceptance and health management.

On the other hand we know that financial costs, management changes, and educational problems must be deeply evaluated to support useful utilization of robotics and new technologies in neurorehabilitation.

The main objective of this article is to offer some recent information about scientific documents and suggestions to extend the discussion to these new challenges that stakeholders are dealing with, considering recent developments of RT.

Background

RT availability has been enormously increasing in all countries.

The field of these treatments was at first NR (stroke, SCI, TBI, MS) but now there is increasing utilization in musculoskeletal impairments and disabilities after bone and joint traumatisms and prosthesis: as a matter of fact, in these fields too they are preeminent for the recovery in many aspects of cognitive and neuro-functional training and new technologies can support them very strongly, reducing times and enriching outcomes and patient's satisfaction.

Treatment programmes are now designed for almost all disabilities and fields of neurorehabilitation and occupational therapies (OT) for the recovery of correct managements of Active Daily Living (ADL) and vocational tasks improvement.

Ultimate objective of RT is to contribute to the effective improving of the lives of people with disabilities and elderly people reducing dependence on others and contributing to integration into their families and society. (2)

Despite this panorama, there are no specific or useful classification of all different devices with regard to the variability, features, aims, this being the basis for uncertainity.

RT is more considered in clinical activities in regard to daily care. This attention in the world of RT is also demonstrated by the steady increase of publications on this topic, it is possible to select more than 900 articles in this scientific field in pub med in the last five years. In August 2014, 36 studies regarding RT were recorded on the website Clinical Trial.Gov.

A clear evidence of a superiority of RT after stroke, and in other diseases, is still lacking leading to controversial statements.

One of the main studies, a single multi-site, independently run, study of robotics now available, is the Veterans Affairs trial CSP-558 (VA-ROBOTICS) on chronic stroke of upper extremity rehabilitation robotics; the commercial version of the MIT-Manus for shoulder-and-elbow therapy together with the corresponding anti-gravity, wrist, and hand robots has been employed. The VA ROBOTICS study demonstrated modest clinical benefit for RT compared with usual care at 36 weeks accepting that, although providing additional care using new technology can be expensive, the total costs were not greater for the robot group than the usual care group. (3)

The recent 2012 Cochrane database on 666 patients considered 19 trials, including 10 trials of the 2008 review and reports better outcomes in the

patients' Activities Day Living as well as improved motor function of the impaired upper limb, but no increase in strength. (4)

The absence of systematic effects may be partially explained by the heterogeneities of studies. (5)

Tha lack of correct outcome measures used in RT may also explain this diffuculty of management of RT, despite a recent review showed that main measures seem to be appropriate for RT studies. (6)

The assessment of RT treatment is a key factor in NR practice and also in research, considering that now we are far from an agreement on the most appropriate measures (7–8).

Even if RT-measured parameters are reliable and can be considered ideal tools to evaluate motor improvement during robot-assisted neurorehabilitation (9), the literature concerning specific outcome measures is still scant; residual motor function, improvement during treatment, and outcomes are still estimated by criteria that are based largely on experience rather than on objective measures.

Two more important issues must be considered and are to be discussed: cost and education. Costs in time and labor of RT rehabilitation are estimated to remain higher than in traditional therapy (10-11).

Financial issues regarding RT and organization of personnel, privacy concerns or educational costs are still arising and remain largely unresolved. (12)

In fact, RT and NR procedures need to be better identified and developed within the mainstream of the neurorehabilitation framework. It is no more a simple issue of robot-patients interaction: this limited sight will prevent RT and NT development to its full potential in neurorehabiliation. (13)

It is actually important to provide correct frameworks and care pathways to develop RT in NR, very often deeply modifying many previously shared clinical and management paradigms.

Discussion

The purpose of this short article is to identify common problems, recognizing the main points regarding the NR and professional competences and activities. Scientific evidences and professional, clinical and management experiences must both be considered to plan better rehabilitation facilities, programmes and interventions. This interaction discloses positive aspects, but also critical issues

in a period when actual great dissemination of media information (Internet, TV, newspapers, etc.) is booming expectations among all stakeholders.

Actually, there is basic kinesiological, static-mechanical or neuro-functional evidence available while the cognitive, behavioural, sensorial and relational elements are however very simple and elementary and are definitely not correlated to overall processes of understanding, learning and functional acquisition for recovery in functioning and participation. (14) (15) (16)

There is a great need for overall rehabilitative verifications on existing equipment, as well as rehabilitative research to better orient companies' technological applications in future.

Moreover, some great positive prospects are emerging, such as new tools to study and clarify modalities of therapeutic interventions; a greater homogeneity and measureability of treatments.

For example:

A big challenge for organization is the cost recognition: critical elements are the management and organisation algorithms in any facilities, individual rehabilitation programme of treatment, and mainly Physical and Rehabilitation Medicine Specialist medical prescription to apply RT. (17) (18) (19)

Actual economical founding may be not enough to expand RT in mainstream NR.

Moreover, limitations and differences exist among Rehabilitation Centres, leading to disparities in treatment.

Another critical element that emerges is the objective need to modify the contents of training for rehabilitation team personnel to promote appropriate use of RT equipment in rehabilitative treatment.

Educational programmes in PRM nowadays pay more and more attention to RT arguments, but this still is little compared to what is needed. This plan of study for students should include direct clinical experiences in areas where technological systems are used both for evaluation and treatment in the patients.

The relationship between PRM and patients is also modified with respect to the substantial aspects of acceptance of new clinical paradigms, protocols and guidelines. (20) (21) (22)

Another big question often arises as to whether RT ought to or may replace specific categories of operational personnel (Physiotherapists, Speech and Language Therapists, Occupational Therapists), perhaps partially regarding some traditional activities, or maybe partially substitute rehabilitative settings where therapeutic programmes were traditionally carried out. Considering these aspects, the theme of the "difficulty" of performing work is also posed. This tends to occur with Physiotherapists, Speech T., Occupational T., and is also one of the elements of adaptation for patients (due to their difficulty) in their progress in performing exercises.

A main problem is the specific new skills of operational personnel, who can supervise and guarantee the precision of these therapeutic procedures. These professionals need new education of a quite different nature, a new role in the global management of treatment programmes, times, measurements and responsibilities, a different cooperation in the Team and with other, more technical professionals, such as programmers and engineers.

The primary need is therefore confirmed for global and individual care for the person in the Individual Rehabilitation Project, in order to bring every intervention to a therapeutic result. This situation is much more complex and requires a solid role for responsibility in the hands of Physical and Rehabilitation Medicine Specialists regarding prescriptions for technological treatments, evaluations of results.

Conclusions

Main problems regarding the actual development of RT in neurorehabilitation Medicine have been discussed and the consequences on the stakeholders have nowadays a high impact not to be dismissed.

Surely this world evolution in favour of the utilization of new technologies in NR (and in all other fields of Rehabilitation) will proceed very fast: it is our task to be actively present to guide, and not just undergo this change.

It is crucial to investigate at a multicentric level (for example at European level), considering different environments and local features, all possible impacts on management of RT to better disseminate new technologies. This main aim may be achieved only through the involvement of scientific societies, educational programmes, universities and the NHS.

Izjava o sukobu interesa

Autori izjavljuju da nemaju sukob interesa.

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