130 - INVESTIGATIVE ANALYSIS OF ULTRASOUND THERAPY ON PHYSIOTHERAPY SERVICES IN THE STATE OF PERNAMBUCO

ANA KAROLINA PONTES DE LIMA
GABRIELA DE ALMEIDA CAVALCANTI
GISELLE CORREIA DE OLIVEIRA ALBUQYERQUE
MARCELO JORGE LINS SMOLIANINOFF
MARIA GORETTI FERNANDES
Programa Institucional de Bolsas de Iniciação Científica PIBIC
Universidade Católica de Pernambuco - Recife; Pernambuco; Brasil
fisio100@yahoo.com.br

INTRODUCTION

Ultrasound was introduced in therapeutic practice between 1930 and 1940, as a thermotherapy resource capable of producing intense heat. Today, it is largely used in physiotherapy to cure more complex skeletal muscle acute and chronic injuries (ROBERTSON and BECKER, 2001; BASSOLI, 2001; FUIRINI and LONGO, 1996; HEKKENBERG and al, 2004).

Therapeutic Ultrasound (TUS) is composed of two functional parts, an electrical energy and a transducer. The electrical energy can convert the electrical network tension in alternate power. Next, this energy is sent to tissues via the transducer, where the alternate power is transformed to mechanic vibrations through piezoelectric effect. Pierre and Jacques Curie were the ones who discovered this phenomenon in 1880. Today, we know this effect is commonly found in some crystalline materials like quartz, and some synthetic ceramics such as lead zirconate titanate present in TUS (STARKEY, 2001; BASSOLI, 2001).

The ultrasounds generated can transmit their energy in two types of pulse regimes, continual or pulsed. Both interaction mechanisms happen simultaneously, but it is possible to increase one effect or the other, while changing irradiation physical parameters like the kind of wave used; the time and the application technique. In pulsed mode, the circuit of the equipment alternates (turns on/turns off) the electric energy as the energy is transmitted in pulses with brief interruptions that minimize the thermal effect of biological tissues. In continual mode, the wave remains constant throughout, as the thermal effect is optimized (BASSOLI, 2001; DYSON, 1987; BAKER, ROBERTSON and DUCK, 2000).

The transmission of the ultrasound wave is through a coupling medium, one of connection agents, as liquids are good conductors of an ultrasound wave. This allows solids to transmit and spread energy more efficiently due to the proximity of their molecules. That is why several studies proved the gel to be the best coupling medium for the transmission of ultrasound energy throughout human body (CAMERON and MONROE, 1992).

In highest intensities, the stable cavity becomes unstable, because it creates explosion and is air bubbles free. The explosion frees a great deal of energy and causes a production of several free radicals that can produce irreversible and serious cellular damages (PLAJA, 2003).

Therapy through TUS has a wide range of therapeutic effects, thus can be useful in various pathologies, like during an inflammatory process that results in a rapid healing with the liberation of growth factors following degranulation of mastocytes, plaquettes and macrophages. Ultrasound therapy may also be used for bone healing, because it promotes long bones longitudinal growth (SCHOTT and GAMEIRO, 2003; YOUNG and DYSON, 1990). Today, the un-standardized state is unknown by the majority of professionals responsible for TUS. To demonstrate that the equipment is sending sound waves, the head must face up, pour a few drops of water on top, and watch if any fog was formed. Some authors say this method is not precise, as it does not exactly measure the intensity that is emitted by TUS, but this simple test is very effective when proving the functioning of the equipment (OLAVE, 2004; PLAJA, 2003). This study is to investigate the quality of ultrasound therapy in the state of Pernambuco physiotherapy services.

MATERIALS AND METHODS

This study is a continuation of a project called “Quality of Ultrasound Therapy in the state of Pernambuco physiotherapy services”, with the following registration number: 436700-FTA-011-2006/1. It is done in conjunction with the “Universidad Católica de Pernambuco (UNICAP), the “Centro de Ciências Biológicas e Saúde”, or “Center for Health and Biological Sciences”, the physiotherapy course, and is characterized by its descriptive nature. Searching for physiotherapy services performing ultrasound therapy in the job market in the city of Recife, then characterizing them, was initially the reason for this study's development. Addresses and telephone numbers from these Pernambuco state physiotherapy services were provided by their registration in the “Conselho Regional de Fisioterapia (CREFITO 1), or the “Physiotherapy Regional Council”. The CREFITO provided a list of 213 physiotherapy services registered in Recife council in which those performing ultrasound therapy were not discriminated. Thus, it was impossible to tell the exact number of physiotherapy services with ultrasound in their disposition. However, our sample will be limited to 60 of them from the city of Recife, Pernambuco, due to difficulties in the realization of the questionnaire, like the resistance of physiotherapists.

The followings will be used throughout this study: first, physiotherapy services in Recife will be contacted by phone to allow the evaluation of TUS equipments via an investigative questionnaire with both free and correct answers on the quality of ultrasound therapy. This questionnaire will provide information about TUS usage, maintenance aspects (checking/calibration), characterization (make, model, type of frequency), type of service (private or public), and so forth.

After the questionnaire, all TUS equipments from physiotherapy services, in Recife, will be checked and submitted to the Test of Fog to see if they work. This test is performed by pouring a small amount of mineral water at the center of the ultrasound's head. Then, the parameters of the equipments are set in continuous mode for about 03 minutes, and the intensity at 0.00 W/cm2. Next, we gradually increase the intensity of the equipment. A fog must be formed at the center of the TUS's head between 1.1 and 1.5 W/cm2.

RESULTS AND DISCUSSION

This study conducted in thirty-nine (39) physiotherapy services from the state of Pernambuco using TUS showed that 87% of them were private, whereas nearly 13% were public. As for the state of the equipments, 59% of those for TUS were good and 31% average. The ultrasound device, according to the American Physical Therapy (2001) is extremely important if we want to increase its performance and guarantee patients' integrity.

The results obtained, when checking the calibration of the equipments following the Test of fog showed that 13% of them formed a fog lesser than 1.1 w/cm^2, a proof they were not calibrated. Also, they would release more energy than necessary for therapy; 28% showed formation of fog between 1.1 w/cm^2 and 1.5 w/cm^2, while indicating the perfect calibration for therapeutic application, and 28% of intensity higher than 1.5 w/cm^2 with less emission of energy than necessary for treatment, which proved they weren't calibrated.

About 31% of services had equipments where the fog was invisible, thus showing the equipment was not functioning within the recommended norm. The calibration is important because, it is from it that the therapist uses the correct dosage on the patient. Therefore, a high intensity can cause injuries on tissues and lead to an impairment on the immune system due to the failure of the physical barrier, which in turn increases possible infections (LEMOS, OLIVEIRA and NUNES, 2000).

Our study showed that 61% of physiotherapists used water to clean-up the ultrasound's head, while 31% did not use any substance at all. SHAEFER (1994) acknowledged that aseptic norms are universal and must be applied to all patients, all instruments and equipments. This study is thus relevant as it identifies the way TUS asepsis is performed in physiotherapy services.

BOLICK (2000) also agrees that both education and appropriate trainings are fundamental elements for a better success of security measures, and for controlling infections in physiotherapy services. Thus, a main security measure and infection control after washing hands, authors say, is disinfection and maintenance of equipments used by patients and therapists. In TUS, it is important for professionals to be conscious and emphasize upon cleaning the ultrasound transducer, which is a huge contamination milieu.

The cleaning of ultrasound transducer was of an interest in our study because, it is an excellent data for identifying risks patients may encounter after using it without proper asepsis. REY (1999) corroborates with this as he points out that, the frequency of positivity for bacterial and fungal agents in ultrasounds piezoelectric transducers is 25%, and 40%, respectively.

When performing TUS, there must be a coupling medium to free the air between the transducer and the tissue, for the energy from the ultrasound get to the targeted tissue. In general, the mostly used coupling mediums are the ultrasound gel, some oils like Vaseline and water. (DOCKER et al., 1982, DRAPER et al., 1993, DYSON, 1987, HAAR, 1998).

According to our questionnaire, 100% of professionals used ultrasound gel as a coupling medium, and 23% of them a medicated gel for phonophoresis.

Phonophoresis consists in using topically applied drugs through the skin, and directed by ultrasound energy to the subjacent tissue. About 75% of studies (BYL, 1995) confirm its efficiency, though other authors said to have obtained negative results.

As for the calibration and the maintenance of equipments our findings were confirmed by Kitchen and Bazin (2003) who recognized the necessity of a more adapted education on behalf of professional physiotherapists when performing TUS.

Table 1 - Characteristics presented to Physiotherapy services.

VARIABLES	(n = 49)	%
Service Profile		
Public	6	13%
Private	43	87%
State of equipments		
Good	30	59%
Fair	15	31%
Bad	5	10%
Dosage recorded on the Test of fog		
Less than 1.1 w/cm^2	6	13%
Between 1.1 e 1.5	14	28%
Above 1.5	14	28%
No fog was formed	15	31%
Cleanness of headstock		
No substance is used	15	31%
Water	30	61%
Icohol	4	8%
Coupling Medium		
Ultrasound gel	49	100%
Test of fog description		
Incorrect	49	100%

Source: FERNANDES et al, 2008

CONCLUSIONS

Based upon data collected here, it has been proven that ultrasound therapy is chosen as a form of treatment by several professionals in physiotherapy, due to its great importance on patients' evolution. Thus, it must be used appropriately, which was not the case in our research.

Ultrasound waves can damage tissues, if used inappropriately; which is a worry in public health. A great deal of people use physiotherapy services, as we have seen, but some professionals are negligent when using TUS instruments which were, in most part, un-calibrated and in poor conditions; the same as a correct asepsis on the ultrasound transducer was also not observed.

Thus, there is the necessity of training professionals as for TUS and its maintenance, because several equipments are such in bad conditions that they can barely be used as placebos during therapy.

REFERENCES

American Physical Therapy Association (APTA). Guide to physical therapy practice. On What concepts is the guide based ? **Phys Ther**. v. 81, n 1, p.19-25, 2001.

BASSOLI, D. A. **Avaliação dos efeitos do ultra-som pulsado de baixa intensidadena regeneração de músculos esqueléticos com vistas à aplicabilidade em clínicafisioterapêutica**. Dissertação (Mestrado) Escola de Engenharia de São Carlos /Faculdade de Medicina de Ribeirão Preto / Instituto de Química de São Paulo, 2001.

BAKER, K. G.; ROBERTSON, V. J.; DUCK, F. A. A review or therapheutic ultrasound: biophysical effects. **Physical Therapy**, v. 81, n. 7, p. 1351-1358, jul. 2001.

BOLICK, D. **Segurança e controle de infecção.** Rio de Janeiro: Reichamann e Affonso Editores; 2000.

BYL, N. N. The use of ultrasound as an enhancer for transcutaneus drug delivery: phonophoresis. **Physical**

Therapy, v. 75, p. 481-488, 1995.
CAMERON, M. H.; MONROE L. G. Relative transmission os ultrasound by media customarily used for phonophoresis. **Physical Therapy**, [S.l], ano 72, n. 2, p. 142-148, 1992.
DEYNE, P. G.; KIRSCH-VOLDER, M. In vitro effects therapeutic ultrasound on the nucleus of human fibroblasts. **Physical Therapy**, v. 75, n. 7, p. 629-634, jul. 1995.
DOCKER, M. F.; PATRICK, M. K.; FOUKLES, D. J. Ultrasound couplants for physiotherapy. **Phisiotherapy.** London, v. 68, n. 4, p. 124-125, 1982.
DRAPER, D. O.; SUNDERLAND, S.; KIRKENDALL, D. T. A comparison of temperature rise in human calf muscle following applications of underwater and topical gel ultrasound. **Journal of Orthopaedic Sports and Physical Therapy.** Washington, v. 17, n. 5, p. 247-251, 1993.
DYSON, D. Mechanisms Involved in Therapeutic Ultrasound. **Psysiotherapy**. v. 73, n. 3, p. 116-119, 1987.
FUIRINI JR, N. LONGO, G.J. **Ultra-som**. Amparo: KLD Biossistemas equipamentos eletrônicos Ltda, 1996.
HAAR, G. Princípios eletrofísicos. In: KITCHEN, S.; BAZIN, S. **Eletroterapia de Clayton .** São Paulo: Manole, 1998.
HEKKENBERG, R. A. et al. Development of transfer standard devices for ensuring the accurate calibration of ultrasonic physical therapy machines in clinical use. **Journal of Physics** v. 1 n.1 p. 99-104, 2004.
KITCHEN, S.; BAZIN, S. Eletroterapia**: prática baseada em evidências.** São Paulo: Manole, 2003.
LEMOS, M.; OLIVEIRA, J.S.; NUNES, C.B. Análise preventiva dos fármacos utilizados nos recursos fisioterápicos. **Reabilit**. 2000.
OLAVE, I. E. A. **"Evaluación de la calibración de los equipos de ultrasonido terapéuticos de los Servicios de Salud Pública Metropolitana"** Universidade do Chile/ Faculdade de Medicina/ Escola de Cinesiologia, Chile, 2004.
PLAJA, J. **Analgesia por Medios Físicos,** Editorial Mc Graw-Hill, 2003
REY, L. **Dicionário de termos técnicos de medicina e saúde.** São Paulo: Guanabara-Koogan, 1999.
ROBERTSON, V. J.; BAKER, K. G. A review of therapeutic ultrasound: effectiveness studies. **Phys Ther**. V.81, p.1339-1350, 2001.
SCHAEFER, M. B. The New CDC surgical water recommendations: why they should be implemented and what they require. **Compend Cont Educ Dent.** 1994.
SCHOTT, P.C.M.; GAMEIRO, V. S. Fraturas e lesões epifisárias. In: HEBERT, Sizínio XAVIER, Renato. **Ortopedia e traumatologia princípios e prática**. 2a ed. PortoAlegre: ArtMed p. 895-899, 2003
STARKEY, C. **Recursos Terapêuticos em Fisioterapia**. São Paulo: Manole, p.279-313, 2001.
YOUNG, S. R.; DYSON, M. Effect of therapeutic ultrasound on the healing of full-thickness excised skin lesions. **Ultrasonics**, London, v. 28, p. 175-180, 1990.

Rua Real da Torre 1448, apt 201 Madalena
Recife PE CEP 50710-100
e-mail: fisio100@yahoo.com.br

INVESTIGATIVE ANALYSIS OF ULTRASOUND THERAPY ON PHYSIOTHERAPY SERVICES IN THE STATE OF PERNAMBUCO

ABSTRACT

Ultrasound was introduced in therapeutic practice between 1930 and 1940 as a thermotherapy resource capable of producing intense heat. Ultrasounds generated can transmit their energy in two pulse regimes, continuous or pulsed. The transmission of an ultrasound wave comes from an applicator head; the gel is the best coupling medium for releasing ultrasound's energy. Most professionals responsible for TUS, today, ignore the un-standardized state. Investigate the quality of ultrasound therapy in the state of Pernambuco physiotherapy services. The sample will have 49 physiotherapy services from the state of Pernambuco where the apparent state of TUS equipments and their maintenance were both analyzed following a questionnaire and salt spray test performance. The study showed that 87% of services were private and 13% public; 59% of TUS equipments from physiotherapy services good and 31% fair. Results obtained upon checking equipments adjustment, and the Test of fog performance, showed that 13% of them had a fog under 1.1 w/cm^2 ; 28% between 1.1 w/cm^2 and 1.5 w/cm^2; 28% with the intensity above 1.5 w/cm^2. About 31% of businesses presented equipments in which the fog was not apparent. Our results showed that TUS equipments in the state of Pernambuco physiotherapy services are giving an incorrect dosimeter, which suggests that they are lacking standard qualities established by technical norms.

KEY-WORDS: Quality, Test of Fog, Therapeutic Ultrasound

ANALYSE INVESTIGATIF DE LA THÉRAPIE ULTRASONIQUE DANS LES SERVICES DE PHYSIOTHÉRAPIE DE L'ÉTAT DE PERNAMBUCO

RESUME

L'ultrason a été introduit dans la pratique thérapeutique entre les années de 1930 et 1940 comme une ressource termoterápico capable de produire la chaleur profonde. Produits ultrasoniques possèdent la capacité d'émettre leur énergie dans deux régimes de pouls, continuum ou battu. La transmission de la vague ultrasonique se produit à travers demi coupleur, le gel est parfaite à moitié coupleur pour émission de l'énergie ultrasonique. Actuellement l'état de descalibração est méconnu par à la majorité des professionnels responsables de UST. Enquêter la qualité de la thérapie ultrasonique dans les services de physiothérapie de l'état de Pernambuco. L'échantillon se composera de 49 services de physiothérapie de l'État de Pernambuco. où il s'est analysé, à partir de l'application d'un questionnaire et de la réalisation de l'essai de la brume, de l'état évident de l'équipement et de la manutention de UST. L'étude il a révélé que 87% des services présentait caractère particulier et environ du 13% présentaient caractère public. Combien à l'état des équipements des services de physiothérapie, il a été révélé que 59% de UST se trouvait dans bon état et 31% été régulier. Les résultats trouvés pendant la vérification du calibrage des équipements à partir de la réalisation de l'essai de la brume, ont révélé que 13% des appareils a présenté la brume au-dessous de 1.1 w/cm2, 28% ont présenté la formation de la brume entre 1.1 w/cm2 et 1,5 w/cm2, et de 28% dans une intensité au-dessus de 1.5 w/cm2. Environ 31% des ils cabinets de consultations ont présenté des équipements où la brume n'a pas été représentée. Conformément aux résultats de ce travail il s'est observé que les appareils de UST dans les services de physiothérapie de l'état de Pernambuco émettent une dosimétrie incorrecte en suggérant que les mêmes ne présentent pas les normes de qualité établies par les normes techniques.

MOTS-CLEF: Qualité, Essai de la Brume, Ultrason Thérapeutique.

ANÁLISIS INVESTIGATIVA DE LA TERAPIA ULTRASÓNICA EN LOS SERVICIOS DE FISIOTERAPÍA DEL ESTADO DEL PERNAMBUCO RESUMEN

El ultrasonido fue introducido em la práctica terapéutica entre los años de 1930 y 1940 como un recurso de la termoterápia capaz de producir calor profundamente. Los generadores ultrasónicos presentan la capacidad de emitir su energía en dos maneras, en modo pulsado y continuo. El estado del descalibración es actualmente desconocido por la mayoría de los profesionales responsables por el equipo. Investigar la calidad de la terapia ultrasónica en los servicios del fisioterapía del estado del Pernambuco. La muestra fue compuesta por 49 servicios del fisioterapía del estado del Pernambuco. Donde si analizaba los equipos de ultrasonido con el uso de un cuestionario y de la realización de la prueba de la niebla y del estado evidente del equipo y del mantenimiento de lo mismo. El estudio divulgó que el 87% de los servicios presentaron el carácter particular y el cerca de 13% presentarón el carácter público. Cuánto al estado del equipo de los servicios del fisioterapía los resultados encontrados durante la verificación de la calibración del equipo en la realización de la prueba de la niebla, habían divulgado que el 13% de los dispositivos habían presentado la niebla abajo de 1.1 w/cm^2, 28% habían presentado la formación de la niebla entre 1.1 w/cm2 y 1.5 w/cm^2 y 28% en una intensidad arriba de 1.5 w/cm^2. Cerca de 30% de los servicios del fisioterapía habían presentado el equipo donde la niebla no fue visualizada. De acuerdo con los resultados de este trabajo fueron observados que los dispositivos de ultrasonido en los servicios del fisioterapía del estado del Pernambuco están emitiendo una dosimetria incorrecta que sugiere que los mismos no presentan los estándares de la calidad establecidos por las técnicas de las normas.

PALABRAS-LLAVE: Calidad, prueba de la niebla, ultrasonido terapéutico.

ANÁLISE INVESTIGATIVA DA TERAPIA ULTRA-SÔNICA NOS SERVIÇOS DE FISIOTERAPIA DO ESTADO DE PERNAMBUCO

RESUMO

O ultra-som foi introduzido na prática terapêutica entre os anos de 1930 e 1940 como um recurso termoterápico capaz de produzir calor profundo. Os gerados ultra-sônicos possuem a capacidade de emitir sua energia em dois regimes de pulso, contínuo ou pulsado. A transmissão da onda ultra-sônica ocorre através de um meio acoplador, o gel é o mais perfeito meio acoplador para emissão da energia ultra-sônica. Atualmente o estado de descalibração é desconhecido pela maioria dos profissionais responsáveis pelo UST. Investigar a qualidade da terapia ultra-sônica nos serviços de fisioterapia do estado de Pernambuco. A amostra será composta por 49 serviços de fisioterapia do Estado de Pernambuco. onde se analisou, a partir da aplicação de um questionário e da realização do teste da névoa, o estado aparente do equipamento e a manutenção do UST. O estudo revelou que 87% dos serviços apresentavam caráter particular e cerca de 13% apresentavam caráter público. Quanto ao estado dos equipamentos dos serviços de fisioterapia, foi revelado que 59% dos UST encontravam-se em bom estado e 31% em estado regular. Os resultados encontrados durante a verificação da calibração dos equipamentos a partir da realização do teste da névoa, revelaram que 13% dos aparelhos apresentaram a névoa abaixo de 1.1 w/cm^2, 28% apresentaram a formação da névoa entre 1.1 w/cm^2 e 1.5 w/cm^2, e 28% numa intensidade acima de 1.5 w/cm^2. Cerca de 31% dos consultórios apresentaram equipamentos em que a névoa não foi visualizada. De acordo com os resultados deste trabalho observou-se que os aparelhos de UST nos serviços de fisioterapia do estado de Pernambuco estão emitindo uma dosimetria incorreta sugerindo que os mesmos não apresentam os padrões de qualidade estabelecidos pelas normas técnicas.

PALAVRAS-CHAVE: Qualidade, Teste da Névoa, Ultra-Som Terapêutico.