EFFECT OF TRANSCUTANEOUS ELECTRO-STIMULATION IN AMBULATORY POSTOPERATIVE REHABILITATION TREATMENT IN THORACIC SURGERY.

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PNEUMOCAN GRANT PROJECT

CONCEPTUAL FRAMEWORK.

INTRODUCTION. PAIN ASSESSMENT

The best analgesic agent is the one that reduces pain as much as possible with the lowest incidence of adverse effects (1). When explaining what pain is, what is known about it and especially how it is evaluated in order to be able to make an adequate treatment plan within the intervention methodology of any health profession, it is necessary to have a correct knowledge of the different theories that explain pain. In this sense, there are many theories that have sought to explain the experience of pain. There are many branches of science that explain it, such as physiology, psychology and anthropology.

1. Theory of pain specificity.

   It is one of the oldest and attempts to explain the transmission of pain. It is based on the concept that there is always a cause-effect relationship in the perception of pain (nociceptors, which project impulses onto specific pain nerve pathways).

   (A-delta (Aδ) and C-fibres) down the spinal cord to the brain).

2. Pain pattern theory.

   This theory emerged when it was shown that nociceptors responded to stimuli such as pressure and temperature, not just pain. It suggests that there are no specific nociceptors for pain, and that these result from a combination of stimulus intensity and the central summation pattern of impulses in the dorsal horn of the spinal cord.

3. Theory of gate control in pain perception.

   This theory is based on the two previous theories and is widely used in the clinic, although it is not fully supported by experimental evidence. It was proposed by Melzack and Wall in 1965. According to these authors, pain passes through a series of nerve pathways, through which it has to pass through gates. This theory proposes that pain must reach a level of consciousness before it is perceived, and if it can be prevented, the perception is reduced or eliminated. (2)

   What is important in this theory is that the closing mechanism of the various gates or the control of the gate can be realised in various ways:

   - Activation of large diameter nerve fibres. This consists of stimulating large diameter nerve fibres at the level of the skin (which is rich in these fibres) in various ways. Some examples are achieved through massage therapy, vibrotherapy and rhythmic rubbing.

- The generation of sensory stimuli other than pain. The brainstem reticular system can inhibit incoming stimuli, including pain, if the person is receiving different sensory stimuli, because it emits signals that close the gate.

- Decrease unnecessary distress or depression. The gates are closed by inhibitory signals from the cerebral cortex and thalamus, produced by receiving appropriate information about the conditions that generate the painful sensation. (2)

4. Endorphin and non-opioid theory of pain perception.

   It involves the identification of narcotic-like substances secreted by the human body called endorphins. These substances act by locking onto narcotic receptors on nerve endings in the brain and spinal cord to block the transmission of the pain signal and thus prevent the impulse from reaching the level of consciousness.

   - Factors that increase them: brief pain, brief stress, physical exercise, acupuncture, transcutaneous electrical stimulation and sexual activity.

   - Factors that decrease it: prolonged pain, recurrent stress, anxiety and depression (2).

5. Opioid multi-receptor theory for pain sensation.

   It states that in the Central Nervous System, at the spinal and supraspinal level, narcotics relieve pain through various pathways, which may complement, compete or be specific to it. These areas are called *mi, kappa* and *sigma*. The *mi* receptor area produces supraspinal and probably spinal analgesia, respiratory depression, physical dependence, tolerance, constipation and euphoria. The *kappa* receptor zone produces analgesia at the spinal level, sedation, but not respiratory depression or physical dependence, and the *sigma* receptor zone produces vasomotor stimulation and possible psychostimulant effects (hallucinations) (2).

6. Psychological theory of pain.

   Human behaviour is the main part of this theory. For this theory, pain is an abstract concept, which refers to a personal and private sensation of harm and, rather than a sensation, it is an unpleasant emotional experience, which is best defined as the awareness of a state of need. (2)

After the above, a specific approach is made to the assessment of pain from the point of view of physiotherapy. Pain is not an easy sensation or situation to analyse, evaluate and consequently treat. The treatment of pain, both as a symptom and as a problem, must be approached and dealt with as scientifically and objectively as possible. Therefore, the necessary measures are developed to exercise this professional power.

The main problem is the conversion of an absolutely subjective problem into an objective one. The different levels of action, previously developed by authors such as Tomas Gallego in his book *Bases teóricas y fundamentos de la Fisioterapia (Theoretical bases and foundations of physiotherapy),* are developed below.

Pain measurement methods

We will define three ways to measure pain:

- Verbal methods.
- Behavioural assessments.
- Physiological measures.

Verbal methods.

- Clinical interview. Its purpose is to approach the sensory aspects of pain. It is used to measure chronic pain. Data will be collected in relation to:
    - Chronology in the patient's history. Age, form of onset, evolution, treatments carried out, circadian rhythm throughout the day.
    - Localisation on the body schema.
    - Characteristics of pain: intensity, qualities.
    - Pain behaviours. Pain-informed behaviours, maladaptive behaviours, reinforced by the environment.
- Self-reports. They measure sensory aspects of pain. Simple instruments used to assess acute pain. The visual analogue scale (VAS) is the best known.
- Standardised tests. The McGill questionnaire is the most widely used, measuring sensory, affective and behavioural aspects (3).

Behavioural assessments.

Its function is to assess how personality influences the manifestation of pain, it attempts to discern when suffering is caused by pain and when it is caused by the personality of each patient. The Minnesota Multiphasic Personality Inventory (MMPI) is the most commonly used and considered the most valid scale.

Physiological measures.

The measurement of a physiological process involved in pain could provide objective evidence that would allow great advances in the study of this field. Aspects such as electromyography, electroencephalography, heart rate, autonomic indices, etc. could be measured.

(heart rate, blood pressure, body temperature, skin conductance), evoked potentials and others are studied in this section (3).

POSTOPERATIVE PAIN MANAGEMENT

Inadequate perioperative pain control causes serious medical complications, prolonged hospital stay and unnecessary suffering. For this reason, it is important to implement the best management strategies (1).

Pain has a subjective and individual part, which is influenced by emotional factors, personality, socio-cultural aspects, as well as the patient's previous experience with pain. However, it is clear that there is also an objective part. It has been demonstrated that poor pain control increases the patient's morbidity, as it acts on all systems: at the cardiovascular level, intense pain releases catecholamines, which can cause arterial hypertension, arrhythmias and even shock; at the respiratory level, it decreases lung function and increases oxygen consumption, as well as decreasing intestinal motility and making urination difficult. It also produces other less serious but equally important disorders, such as anxiety, insomnia and hormonal stimulation (4).

One of the main fears that patients express before undergoing surgery is the pain that surrounds the whole surgical process, a fear that is justified if we take into account that:

- The pain that can be caused by the healthcare activity itself through the use of drains, lines, catheters and postural changes, among others, is often overlooked.
- Lack of standardisation in pain records, occurrence, intensity, measures taken to reduce pain (4).
- Lack of knowledge on the part of the personnel responsible for the care of the post-surgical patient of the physiopathology of pain, the pharmacology of the various analgesics and psychological factors that affect pain (4) (5).
- Post-surgical pain is not given the necessary importance, and this is perhaps the most important point.

The above can be summarised by stating that post-surgical pain is an acute pain, with exacerbation of emotional and perceptual experiences that will be associated with autonomic and psychological reflex responses.

Pain associated with wounds imposes activity limitations and thus prevents aggravation of the pathology causing the pain. Acute postoperative pain has no useful function and if unrelieved will produce abnormal physiological and psychological responses that often cause complications. These responses are classified as:

1- Segmental responses.

2- Suprasegmental responses.

3- Cortical responses.

<u>Segmental responses.</u>

These are reflex responses that cause an increase in skeletal muscle function, which may result in a decrease in chest wall compliance. Stimulation of preganglionic sympathetic neurons in the anterolateral horn of the spinal cord results:

- Increased cardiac output.
- Increased myocardial O_2 consumption.
- Vasoconstriction segmental which can decrease the function urinary and gastrointestinal function, favouring the development of paralytic ileus. (5).

Suprasegmental responses.

They result from the stimulation of respiratory and cardiovascular spinal centres which can cause:

- Hyperventilation.
- Increased sympathetic tone.
- Increased secretion of catecholamines, cortisol, ACTH, glucagon and other catabolic hormones (5).

If segmental responses are added to the above, higher cardiac output and increased peripheral vascular resistances are evident, resulting in increased blood pressure and thus a generalised increase in O consumption$_2$.

Metabolic responses include:

- Increased plasma glucose level.
- Increase in cyclic AMP.
- Increased free fatty acids, lactates and ketones
- Widespread increase in basal metabolism (5)

With all this, the patient tends towards a negative nitrogen balance.

Cortical responses

These responses include not only the perception of pain as an unpleasant sensation, but also the initiation of dynamic mechanisms such as anxiety, apprehension and fear (5).

Acute postoperative pain is pain that occurs when a patient undergoes surgery, either associated with the surgical procedure and the pre-existing disease or a combination of both (1).

For proper postoperative pain control, effective and safe analgesic management during the perioperative period (preoperative, intraoperative and postoperative) should be carried out, as well as to avoid future sequelae. Specifically, this involves:

1. Minimise the incidence and severity of acute perioperative pain.
2. Educate patients and their families about the importance of their involvement in effective pain management.
3. Improving patient wellbeing.
4. To reduce postoperative complications secondary to pain management and, as far as possible, the length of hospital stay (1).

CONTEXTUALISATION OF PAIN

Pain following thoracic surgery has a number of particular characteristics:

- It is considered the most severe acute postoperative pain.
- Theinadequate control of pain favours the occurrence of serious postoperative complications such as atelectasis and respiratory infections.
- Adequate relief allows for intensive physiotherapy, reducing the occurrence of such complications.
- Functional residual capacity (FRC) decreases (6).

Several mechanisms are involved in the aetiopathogenesis of this pain, including the following:

- Surgical incision.
- Lung resection.
- Pleural drainage tubes.
- Inflammation.
- Injury to intercostal nerve or costal spinal roots (6)

Potential problems may also arise, such as limitation of movement in the upper limbs and rib cage, muscle shortening (derived from the surgical act itself) and the consequent reduction in joint range (7).

PAIN AND PHYSIOTHERAPY

In accordance with the concept of Science, defined by the Royal Academy of the Spanish Language as *"a methodically formed and ordered body of doctrine that constitutes a particular branch of human knowledge", in order to describe, interpret and analyse how Physiotherapy as a Science approaches pain, it is necessary to describe and deepen the concept of pain from the point of view of Physiotherapy.* [3]In order to describe, interpret and analyse how Physiotherapy as a Science approaches pain, it is necessary to describe and analyse the concept of pain from the point of view of Physiotherapy.

There are three types of pain from a physiotherapy point of view:

a. Pain of biochemical origin.

b. Pain of neuralgic origin.

c. Pain of mechanical origin.

Biochemical pain results from local metabolic and electrochemical disturbances due to acute inflammation, tissue tears and vascular ruptures. It consists of the irritation of abnormal nerve endings due to oversaturation of unusual substances, which are intended to be eliminated. Within the physiotherapeutic examination, it would be those pains that appear on tissue palpation. The visual appearance is usually accompanied by redness. Touch is used to detect heat radiation if the inflammation is acute, or crusting and induration if the process is chronic.

Pain of neuralgic origin is that which appears when a nerve root is damaged, pinched or demyelinated in its pathway, with the fundamental characteristic that it reflects in its area of innervation: tingling, numbness, pain and neurovegetative, sensory and motor insufficiency. Its most frequent manifestation is radiating pain, with a trajectory, deep localisation, it is not palpable, it manifests itself both in activity and at rest, it is accentuated in certain postures and relieved in others. If the neuralgic pain is acute, it has the characteristic of being able to cause functional impotence and large defence contractures.

When there is excessive compression of a structure, excessive elongation in a tissue or group of tissues or permanent crushing, mechanical pain is defined. It is caused by mechanoreceptors, which report aggression instead of normal proprioception (8).

TRANSCUTANEOUS ELECTRICAL STIMULATION

In 2010, J.J. Amer-Cuenca published a scientific article in the journal "Fisioterapia" with the following title: "Programming and application of transcutaneous electrical nerve stimulation (TENS): evidence-based clinical practice guide". The beginning of this article is literally: *"Transcutaneous electrical nerve stimulation, known by the acronym TENS, consists of the application, by means of surface electrodes, of pulsed electrical current for analgesic purposes. The current use of TENS in the clinical field of physiotherapy is very widespread. It can be said that, together with interferential stimulation, it is the most widely used electrical stimulation technique as an alternative to traditional analgesic treatments, such as pharmacological or surgical treatments. Its popularity is based, among other aspects, on the fact that it is a non-invasive technique, easy to administer, has few side effects and interactions with other drugs, cannot produce overdoses, and is a very economical technique that can be used for home treatment after a period of training of the patient himself"*. (9)

Similarly, this author draws the following analogy: *"...to point out the proper selection of parameters, the characteristics of the electrical impulse (shape, duration, frequency) would be the active element of TENS therapy, just as the chemical components are the active element of a drug. In addition to the proper selection of the parameters, the correct dosage and application of the parameters (intensity, size and placement of the electrodes, as well as the mode of stimulation) is fundamental. The effectiveness of TENS treatment depends on the correct combination of all these elements"*. (9)

The conclusions reached by this author in his research are as follows:

- The waveform shall be a symmetrical, compensated pulsed two-phase pulsed pulse.
- The pulse duration must be greater than 250μs.
- The application frequency should be high (greater than 80 Hz).
- The size of the electrodes should be large.
- Electrodes placed directly on the area of pain or corresponding dermatomas.
- The intensity should be as high as possible without causing pain (9).

Reviewing the history of the relationship between physiotherapy-pain-transcutaneous electrical stimulation, in 1997, Fabrizio Benedetti et al., after carrying out a study on 324 patients who underwent surgery for various procedures: posterolateral thoracotomies, thoracotomies with muscle transposition, costotomies, stereotomies, thoracoscopies, demonstrated that the application of TENS was effective in operations with little pain and did not demonstrate effectiveness in pain control in patients who underwent operations considered to be painful.

This dichotomous model differentiates between the different levels of pain patients undergo following this surgery. This work used three groups of patients:

1. First group to receive TENS with high-frequency stimulation, with an asymmetric wave type, 100 Hertz frequency and phase duration of 200 µs.

2. The second group, placebo group, was given the same treatment, but in this group the TENS was applied without batteries.

3. Third or control group that received conventional pharmacology to control pain (10).

Later, V.M. Rocha et al. in their article ″Behaviour of pain and the use of neurotranscutaneous electrical stimulation in the postoperative period after thoracic surgery″, introduced the use of the Gill pain questionnaire as a novelty and analysed the amount of medication consumed by patients on the second, third and fourth postoperative day. In his discussion he comments that the surgical incision, especially the thoracic incision, leads patients to avoid coughing and deep breathing, which leads to a decrease in vital capacity and functional residual capacity.

It also indicates in its conclusions that TENS is proven to be an effective antalgic and auxiliary tool for physiotherapeutic procedures. In other words, it reduces the painful stimulus caused by surgical trauma, as well as those caused by mobilisation of the patient in the postoperative period (11).

In 2003, Jan Magnus Bjordal and his collaborators established satisfactory results in the application of TENS after surgery, not referring specifically to thoracic surgery. They also establish 85 hertz as the ideal frequency (12).

In 2008, Chih-Chung Chen together with Ghazala Tabasam and Mark I. Johnson in their article ″Does pulse frequency of transcutaneous electrical nerve stimulation (TENS) influence hypoalgesia? A systematic review of studies using experimental pain in healthy human participants″, they conducted a systematic review of thirteen experimental studies from twelve publications. Of these thirteen studies, ten show no significant differences between different frequencies, although one of them does show significant differences indicating that 100 Hertz per second is more hypoalgesic than 10 Hertz per second. In another, the frequency of 4 Hertz per second was superior in its analgesic effect to 100 Hertz. In the last one, it was shown that frequencies between 5 and 80 hz were more hypoalgesic than 2 hz. In view of the above, he concludes that frequency is not a determining factor when the intensity, pattern and duration of the phase are constant (13).

This aspect of TENS application has an influence not only on the field in which this work is carried out. In chronic muscle pain, TENS has developed as an important agent of analgesia by stimulation of opioid receptors (14).

In this regard, significant differences have been found in various physical therapy treatments comparing TENS with other procedures such as massage (15).

Its effectiveness has also been demonstrated in the treatment of degenerative pathologies as shown by Luis Gerardo Domínguez-Carrillo (2001) (16).

In 2009, Anne Freynet and Pierre-Emmanuel Falcoz reviewed nine papers published between 1980 and 2007. In their conclusions they indicate that in seven of the nine studies TENS is used as an adjuvant to analgesic medication. Significant differences in pulmonary ventilation are thus demonstrated (17).

Fabiana Cristina Ferreira and her colleagues later carried out a study in 2011 with thirty patients who had undergone lung cancer surgery and tested the effect of the application of TENS. They formed two groups and applied TENS to one of them, using the other group as a control group. Their results show a significant analgesic effect with the patient at rest, with this effect diminishing when the patients are asked to raise their upper limbs, move from supine to lateral decubitus or cough (18).

In July 2011, D. Groppetti and colleagues published the paper: *Effectiveness of electroacupuncture analgesia compared with opioid administration in a dog model: a pilot study.* This study concludes that the results obtained from this research show evidence that electroacupuncture is an alternative technique to achieve postoperative analgesia in dogs (19).

DOSAGE OF TRANSCUTANEOUS ELECTRICAL STIMULATION. TENS.

From another point of view, it has been studied since 1981 that the frequency of TENS, high or low, works in different ways. In several studies and publications, Sluka analyses how TENS acts from a biochemical point of view, acting on different opioid receptors. Thus, in his article *"Spinal Blockade of opioid receptors prevents the analgesia produced by TENS in arthritic rats"*, he states that Abrahams et al. have already studied the effects of high frequency and proposed that this mode of application produces analgesia based on the *Control Gate Theory. In* contrast, Sjond and Erikson propose that low frequency TENS derives its effect from opioid release (20).

Therefore, high frequency causes analgesia during its application while low frequency causes longer lasting analgesia. That is, the effect of high frequency is mediated by δ opioid receptors, whereas low frequency will be influenced by μ opioid receptors (20).

In another paper, Campbel and Tamb (1973), define that the control gate theory could be used to explain the actions of high frequency TENS application, although they also suggest that high frequency blocks nociceptive conduction through δ receptors.

The release of endogenous opioids is used to explain the action of low frequencies. This is explained in humans by the use of the opioid receptor antagonist naloxone at low frequency application, which is not the case at high frequency. However, high-frequency stimulation is inhibited by high-dose naloxone administration in rats or spinal administration of a selective δ-receptor antagonist.

Similarly, high frequency increases the concentration of β-endorphins in cerebrospinal fluid in humans. These results are probably obtained by the different modalities of TENS application according to their frequency (21).

From 2005 onwards, the greatest research activity in this aspect of defining TENS and its analgesic capabilities was developed. Sluka establishes the appropriate analysis and the necessary research that generates a revolution in this therapy modality. In this period, TENS (*Transcutaneous electrical nerve stimulation*) was defined as the most commonly used non-pharmacological treatment for the treatment of pain. (22) In this article, two different frequencies were evaluated for TENS, 4 Hz and 100 Hz, demonstrating that the high frequency and not the low frequency significantly reduced the level of aspartate and glutamate in animals with joint inflammation.

POSTOPERATIVE RESPIRATORY CARE

There are several respiratory cares that should be performed in every post-surgical patient, among them are the following:

1. Effective analgesia, being essential the complete elimination of pain to facilitate the elimination of secretions and to be able to carry out effective Respiratory Physiotherapy.

2. Oxygen therapy is administered to treat or prevent hypoxaemia, without influencing airspace abnormalities.

3. Humidification and aerosol treatment, secretions are easier to mobilise if they are moist. Ciliary function is depressed in contact with dry gas.

4. Pharmacological support. Drugs may be administered to facilitate secretion clearance, increase airway calibre or support the cilia expulsion mechanism.

5. Respiratory physiotherapy manoeuvres are aimed at promoting thoracic expansion and increasing the elimination of secretions, thus counteracting the aforementioned facts that can lead to a decrease in lung volumes. (23)

RESPIRATORY PHYSIOTHERAPY IN THE POST-SURGICAL PATIENT

The existence of pulmonary dysfunction is a constant occurrence after abdominal and thoracic major surgery, with these groups of patients presenting between 20% and 40% of postoperative pulmonary complications depending on the series, with a mortality of 16% after the appearance of these complications, being the main cause of morbidity and mortality[23] . One of the important problems after this type of intervention is the reflex inhibition of the phrenic nerve and the decrease in diaphragmatic activity. As a consequence of this process, lung expansion is neither complete nor homogeneous, which favours the presence of pulmonary atelectasis[24] .

This pulmonary dysfunction is mainly caused by the immediate postoperative process and changes in lung function. We can list them as follows:

1. Modifications of respiratory mechanics.
2. Modifications of the respiratory pattern.
3. Modification of gas exchange.
4. Modification of defence mechanisms.
5. Diaphragmatic dyskinesia (23)

Modification of respiratory mechanics

A restrictive problem usually appears, leading to a decrease in lung volumes, with functional residual capacity being reduced by up to 75% or more compared to normal values. The forced vital capacity (FVC) of peak expiratory flow (FEV1) shows average decreases of 40-50% with respect to preoperative values. This decrease in lung volumes increases progressively during the first 24-48 hours of the immediate postoperative period. Return to preoperative values takes 1-2 weeks.

Modification of the breathing pattern

There is also a change in the respiratory pattern. Pain is possibly the main cause, hence all measures aimed at abolishing it during this period. The minute volume is modified, as there is an increase in respiratory frequency which tends to compensate for the decrease in tidal volume that occurs. The second modification observed corresponds to the deep inspirations or sighs that have been abolished. In normal subjects, 9-10 sighs/minute are performed. During the immediate postoperative period, if they exist, they are frequent but of a small amplitude. Moreover, it should be noted that they disappear completely after the administration of morphine. This monotonous, shallow breathing without sighs leads to lung collapse and a decrease in functional residual capacity (FRC).

Modification of gas exchange

The changes described above lead to the appearance of alveolar collapse with decreased ventilation in certain alveolar territories. If perfusion in these territories is maintained, the blood in these alveolar territories will not be oxygenated, creating a right-to-left pulmonary short-circuit. In the less ventilated territories, oxygenation will be partial. These changes lead to the appearance of hypoxaemia, a constant phenomenon in the postoperative period, with a systematic decrease of 10%-20% with respect to baseline values after abdominal and thoracic surgery.

Modification of defence mechanisms

The lung's defence mechanisms against inhalation of particles or infection are also modified. Coughing is the main defence mechanism, as it produces both an inspiration and a large exhalation. The ability to cough and clear secretions is impaired by reduced inspiratory and expiratory reserve capacity. Coughing is inhibited during this period by the pain it produces.

Diaphragmatic dyskinesia

The aforementioned modification of the respiratory pattern would be explained by a decrease in the abdominal diaphragmatic component, with recruitment of the intercostal muscles as a manifestation of diaphragmatic dysfunction.

The most likely mechanism to explain this alteration would be reflex inhibition of phrenic impulses, which does not seem to be linked to pain, as studies with morphine analgesia via thoracic epidural show that diaphragmatic function is not improved, although there is a slight increase when local anaesthetics are administered via this route (23).

Numerous authors agree on the validity of slow and deep inspiratory manoeuvres, the coughing technique with wound restraint and incentive spirometry to prevent respiratory complications (24).

In May 2006, a study was carried out at the Carlos Haya Hospital in Malaga on which type of physiotherapy is more effective in patients undergoing upper abdominal surgery. The aim of the study was to compare classic respiratory physiotherapy with classic respiratory physiotherapy plus incentive spirometry in the preoperative period for these patients. The variables studied were as follows:

- Spirometry; in particular forced vital capacity (FVC), maximal exhaled volume in the first second (FEV_1 or VEMS) and the FEV ratio$_1$ /FVC (FEV_1).
- The six-minute test marches on.
- Thoracometry. The upper, middle and lower circumferences were measured with a tape measure.
- Respiratory frequency.

The most characteristic feature of this study was that classic respiratory physiotherapy proved to be more effective than the latter plus incentive spirometry, with the lower perimeter of the

lower respiratory tract being more effective than the latter plus incentive spirometry.

The treatment was intended to help the patient learn to mobilise the diaphragm as widely as possible by means of deep inhalations, so that after the operation the patient could begin to do so as soon as possible in order to avoid postoperative complications. (24)

The postoperative length of stay of patients who have undergone thoracic surgery depends mainly on the duration of the pleural drainage and the presence of possible complications. Respiratory physiotherapy is one of the existing resources that can reduce this parameter. It is not yet fully implemented in all units, although it is increasingly used and is in full expansion. Correct pain control is essential for the correct application of physiotherapeutic procedures (11).

PREOPERATIVE PERIOD

Pre-operative problems that may negatively influence secretion clearance include advanced age, impaired general condition with inability to cough, presence of COPD with increased expectoration production and/or decreased FVC, asthmatic bronchitis, upper airway abnormalities, and altered gag or cough reflexes.

Respiratory care should be initiated in the preoperative period by identifying patients at risk for respiratory complications and initiating treatment of reversible factors that may respond to treatment (23).

POSTOPERATIVE PERIOD

The primary goal after thoracic surgery is to restore lung expansion and facilitate clearance of secretions. Patients should leave the operating theatre extubated. Unless there are specific contraindications, intubated patients are positioned with the head at 30° to improve functional residual capacity (FRC), facilitating diaphragmatic mobility and shifting the weight of the abdominal viscera away from the lung bases. Aerosols with mucolytic drugs can be prescribed, to which bronchodilators can be added, depending on the patient's clinical situation. Chest expansion is achieved by scheduled sessions of manual ventilation (with ambu) and by adding sighs to mechanical ventilation.

Once extubated, patients are kept in the 30° position and oxygen therapy is administered as needed, with effective analgesia being particularly important in order to initiate deep breaths and mobilise the diaphragm. Aerosols are also started in order to humidify secretions and facilitate their expulsion. In the first few hours, coughing should not be forced, as it is usually ineffective and exhausts the patient. The secretions, once humidified, are easily mobilised and expelled from the bronchial tree. Early mobilisation should be performed (before 24 hours), if the clinical situation permits, as this mobilises all lung areas, improving areas with a poor ventilation/perfusion ratio and facilitating the mobilisation and expulsion of secretions. (23)

OBJECTIVE OF RESPIRATORY PHYSIOTHERAPY

The American Thoracic Society (ATS) defined respiratory rehabilitation as a multidisciplinary programme of care for patients with chronic respiratory impairment that is individually tailored and designed to optimise their physical and social performance and autonomy (25).

The aim of respiratory rehabilitation will be divided into several stages:

a. Bringing the patient to maximum physical potential.

b. To bring the patient to his or her full mental, emotional, social and vocational potential.

c. To reduce symptoms and pathophysiological consequences of respiratory impairment.

d. Decrease the degree of physical incapacity (11)

Within the types of intervention that describe the processes of surgical intervention in Thoracic Surgery, the following are described:

1. Posterolateral thoracotomy. This is the most painful of all surgical procedures due to its high muscular involvement, with resection of the trapezius, latissimus dorsi, the lower portion of the rhomboids, the serratus anterior, the intercostals and the erector spinae.

2. Axillary thoracotomy, often referred to as lateral thoracotomy, used in uncomplicated surgery. Only the intercostal muscles are sectioned.

3. Median sternotomy, used for resection of anterior mediastinal tumours (26).

4. Videothoracoscopy, currently widely used for pleural, pulmonary and mediastinal interventions. One to three incisions of about 2 cm and sometimes an auxiliary thoracotomy of about 5 cm are made.

A pulmonary complication is defined as any pulmonary abnormality occurring during the postoperative period that results in identifiable and clinically significant dysfunction, which adversely affects the clinical course. (26) These are the most common.

These complications are set out in:

1. Auscultation changes (decreased breath sounds, crackles, wheezing, bronchial breathing) greater than those present before surgery.

2. Temperature over 38°.

3. Chest x-ray with changes consistent with collapse, consolidation or atelectasis.

4. Increase in the amount and/or change in colour of sputum production, compared to the patient's usual sputum (26).

Thoracic surgery has a high incidence of complications. The most frequent are atelectasis and respiratory infections, especially pneumonia. Other complications also include arrhythmias, hypotension and shock, myocardial infarction, pulmonary oedema and embolism, respiratory failure, prolonged air leaks and dehiscence, among others (26).

The principles which, in principle, apply are:

1. To achieve effective analgesia in order to be able to perform efficient respiratory physiotherapy. Physiotherapy manoeuvres should always be started after the absence of pain has been achieved.

2. Oxygen therapy, to prevent hypoxaemia.

3. Humidification and aerosol treatment. Its main purpose is to fluidise sputum, humidify the airway, mobilise secretions and administer drugs by inhalation.

4. Pharmacological treatment, in order to clear secretions, increase airway calibre or support the cilia expulsion mechanism.

5. Respiratory physiotherapy, with manoeuvres aimed at promoting thoracic expansion and the elimination of secretions. The following manoeuvres are basic:

    a. Diaphragmatic mobilisation.

    b. Hyperinflation or thoracic expansion therapy.

    c. Postural drainage.

The primary goal of respiratory rehabilitation after chest surgery is to bring the patient to maximum physical potential, as well as to reduce symptoms and pathophysiological consequences of respiratory impairment (23).

Respiratory physiotherapy is essential to achieve thoracic expansion and diaphragmatic mobilisation, avoid diaphragmatic dysfunction and reduce the occurrence of atelectasis and respiratory infections. It should be accompanied by intense analgesia with as few side effects as possible.

The aim of this study focuses on the need, through physiotherapeutic means, to achieve the highest possible level of analgesia for these patients without generating morbidity.

JUSTIFICATION

One of the fundamental bases of physiotherapy is the intervention in pain control. Post-surgical pain in thoracic surgery is considered to be one of the most intense pains that exist. Based on this principle, the aim of this work is to demonstrate that pain control, recovery, readaptation and development of respiratory parameters are normalised with greater precision and in less time.

OBJECTIVE

The objective of the present study, in accordance with the hypothesis determined, will be to demonstrate four points relating to the activity of physiotherapy. These points will be the following:

1. Physiotherapy techniques are an effective element of pain control in the postoperative chest surgery patient.
2. The quality of life of postoperative chest surgery patients improves with the application of analgesic physiotherapy techniques.
3. Respiratory parameters improve in a shorter time if pain control is carried out during respiratory physiotherapy sessions.
4. As a result, the healthcare expenditure involved in caring for these patients decreases considerably.

The objectives of this work are therefore defined as follows:

Objective one: To demonstrate that physical pain control using transcutaneous electrostimulation (TENS) results in effective physiotherapy for the improvement of respiratory capacities.

Objective two: To demonstrate that improvement in respiratory capacity improves patients' quality of life.

Objective three: To demonstrate that effective physiotherapy results in less time spent in outpatient care, leading to a reduction in the case-mix of rehabilitation and a reduction in the health care costs associated with this intervention.

HYPOTHESIS

Physical pain control using transcutaneous electrostimulation (TENS) in patients who have undergone chest surgery allows effective physiotherapy that improves respiratory capacity and quality of life and reduces health care costs.

MATERIAL AND METHOD

DEFINITION OF THE STUDY

This is a prospective, randomised study in which the aim is to study the value of an analgesic technique (TENS). The study will be carried out on patients undergoing thoracic surgery for pleural, pulmonary or mediastinal procedures of varying complexity. Patients will be recruited once the immediate postoperative period has passed, with a deadline of 7 days after the operation for inclusion in the study. There will be three groups of patients:

Group 1.- Patients treated with anterior, lateral or axillary thoracotomy.

Group 2.- Patients treated with videothoracoscopy with three or more entry doors and/or with mini-thoracotomy assistance.

Group 3.- Patients treated with videothoracoscopy with one or two entry doors.

Inclusion criteria

Patients treated with each of the interventions described and who are between 18 and 80 years of age.

Signed informed consent to participate in the study. Exclusion

criteria

Patients operated by any approach other than those described above (median sternotomy, chest wall resection, extended posterolateral thoracotomy, cervical incisions, major chest wall surgery or chest wall deformities).

Patients with pacemakers or other devices that may interfere with the use of TENS.

Patients with chronic diseases requiring the use of corticosteroids or analgesics on a regular basis.

Patients with a history of drug dependence.

Patients with postoperative complications requiring hospital admission.

Patients requiring maintenance of postoperative pleural drainage.

Those patients who meet the inclusion criteria will be recruited, depending on the intervention performed, into one of the three groups referred to. Each of the groups will be divided into two, randomising the patients with random numbers to assign them to one of the three groups.

to each of the subgroups depending on whether TENS therapy is applied. Each group will therefore have two subgroups: a (TENS subgroup); b (control subgroup with conventional therapy).

PHYSIOTHERAPEUTIC TREATMENT

The treatment to be carried out does not differ from that usually carried out in these patients. Therefore, in the control subgroups, treatment will be carried out by means of respiratory physiotherapy and rehabilitation of the thoracic musculature.

In the TENS subgroups (study group), the specific physiotherapy technique for pain control (using transcutaneous electrical stimulation) will be performed. This technique will consist of the application of TENS (figures 1 and 2) using the gate-control theory. For this, we will place two electrodes on both sides of the surgical incision, with the negative electrode being the one furthest from the neural tube and the positive electrode being the most proximal. The application frequency will be 100 Hz (22), the intensity of the application will be that which the patient can bear, the application time will be the same as the duration of the Respiratory Physiotherapy session. The pattern of respiratory physiotherapy will be the same, the treatment will not be modified in any of its stages.

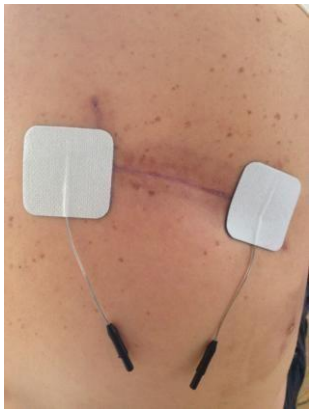

Figure 2.

DATA COLLECTION

All patients likely to be included in the study will undergo a thorough medical history. This medical history will be based on the following aspects:

- Details of affiliation.
- Personal background.
- Type of intervention carried out.
- Incisions made.
- Chronology, location and characteristics of pain.

Once the patient has undergone surgery, the data corresponding to the surgical intervention performed will be collected. Once the period of 7 days has elapsed after the operation and in the absence of complications and pleural drainage, the period of respiratory physiotherapy will begin.

QUALITY OF LIFE ASSESSMENT

The health questionnaire SF-36 (Short Form Health Survey) will be used. This questionnaire is used in medical research, mental health research and health-related research in general. It provides an overview of a person's state of health, with the advantage that it is easy and quick to fill in and simple to evaluate. Similarly, by allowing numerical assessment of different aspects of a person's health, it can be used to assess the health status of the individual.

The questionnaire is an excellent tool for any health-related research. It contains 36 questions that address different aspects related to the daily life of the person filling in the questionnaire. These questions are grouped and measured in 8 sections that are assessed independently and give rise to 8 dimensions measured by the questionnaire.

The eight dimensions are:

1. Physical functioning.
2. Limitation due to physical problems.
3. Body pain.
4. Functioning or social role.
5. Mental health.
6. Limitation due to emotional problems.
7. Vitality energy or fatigue.
8. General perception of health. (Annex 1).

In 1991, the International Quality of Life Assessment Project (IQOLA) was initiated, consisting mainly of adapting and testing the cross-cultural applicability of a generic instrument called the Short Form 36 Health Survey (SF-36) (27).

The Spanish version of the SF-36 is one of the most widely used generic instruments in Spain, both in descriptive studies that measure the impact on HRQOL in different patient populations and for the evaluation of therapeutic interventions (28).

PAIN ASSESSMENT

The tools necessary to make a correct assessment of pain. In this sense, two ways of measuring pain will be established:

1. Self-reports, where the visual analogue scale (VAS) will be the basic measurement tool. Pain will be marked on a scale from 0 (no pain) to 10 (maximum possible pain).

2. The standardised tests, as an objective of the study, also aim to analyse sensory, affective and behavioural aspects of pain in these patients, which is why the Mc Gill test will be the tool to be taken into account (Appendix 2).

ASSESSMENT OF RESPIRATORY FUNCTION

The different respiratory parameters will be measured by spirometry (Siebel spirometer): Forced Vital Capacity (FVC); Forced Expiratory Volume of the first second (FEV_1); FEV1/FVC (Tiffeneau Index).

COST ANALYSIS

Activity times shall be measured in two groups of patients. In all cases, the recovery time and return to normal life will be established. A study of the costs of visits and physiotherapy treatment of these patients until their return to normality prior to the intervention will be carried out.

STATISTICAL STUDY

Data collection will be carried out over a period of three years. There are no reliable data to allow statistical calculation of the sample size, but it is estimated that 30 patients are needed for each of the subgroups described, giving a total sample size of 180 patients.

This is a prospective, randomised, longitudinal study.

STATISTICAL ANALYSIS

Quantitative variables will be described by means of centralisation and dispersion indices: mean, standard deviation and range. The hypothesis of normality of the variables will be verified using the Kolmogorov-Smirnov test for a single sample. Qualitative variables will be treated by analysing the absolute frequency of occurrence of each of the categories, as well as the relative frequencies. Categorical data will be compared using the $\chi 2$ test or Fisher's exact test when necessary. RANOVA will be used when more than 2 means of related variables are to be compared. Student's t-test should be used when comparing 2 related or independent means. In addition, multivariate analysis (multiple linear and logistic regression) will be used for the correct modelling of the relationship between variables. The accepted level of statistical significance is $p<0,05$. Data will be analysed using the statistical package SPSS version 15.0 (SPSS, Inc, Chicago).

REQUEST FOR EVALUATION BY THE CENTRE'S ETHICS COMMITTEE

Immediate application shall be made to the Centre's Research Ethics Committee.

APPLICABILITY OF THE RESULTS

The applicability of the results will be carried out in the Rehabilitation Services that have a Respiratory Physiotherapy unit.

From an economic point of view.

1. The TENS analgesia technique is a low-cost technique and, according to the existing literature, it is effective in the process under study.
2. The existence in the Rehabilitation Services of TENS devices to treat various pathologies means that no new investment is required to apply this technique in this type of surgical intervention.

From a health point of view.

1. Pain control by TENS analgesia may allow for faster recovery of respiratory parameters.
2. Reduced recovery time may result in less use of respiratory physiotherapy units by the patient.
3. The lower use of these units results in a higher turnover rate of patients affected by this intervention in the Rehabilitation Services.
4. This can lead to a reduction in rehabilitation waiting lists.

From a clinical management point of view.

1. The occupancy rate of Respiratory Physiotherapy Units in Rehabilitation Services may decrease significantly.
2. Decreasing the occupancy rate is critical to lowering the cost of the overall expenditure of the Rehabilitation Services.
3. The reduction of pain from physical therapies can lead to consequent savings in pharmaceutical expenditure.

From a quality of life point of view.

1. Improvements in quality of life factors are closely related to pain.
2. The patient's perception of pain can be significantly reduced by the applicability of TENS.
3. Standardisation of optimal quality of life parameters can be achieved in a shorter time.

POTENTIAL PUBLICATION

The use of TENS in the recovery of patients who have undergone thoracic surgery is a subject that has been very little developed to date. We propose that, with a correct methodology, such as the one we have proposed in this study, we can achieve two or more works that can be published in journals with the highest impact in the speciality. We can also propose publications in the field of Rehabilitation and Physiotherapy.

RESEARCH TEAM

Principal Investigator: Dr. Jorge Freixinet Gilart. Tasks: design of the work, performance of surgical interventions and preparation of results, publications and presentations. University Hospital of Gran Canaria Dr. Negrín

Associated Researchers:

David Álamo Arce. Tasks: participation in the design of the work, carrying out the physiotherapy treatment, data collection and participation in the publications and presentations. danieldavid.alamo@ulpgc.es

Daniel López Fernández: participation in the design of the work, physiotherapy treatment, data collection and participation in the publications and presentations.

Dr. Pedro Rodríguez Suárez. Tasks: giving speeches, participation in the production of publications and presentations.

Dr. Agar Santana León. Tasks: carrying out interventions, data collection, participation in the production of publications and presentations.

Dr. Ana Victoria Juárez Sanjuán. Tasks: carrying out interventions, data collection.

Dr. Felipe Rodríguez de Castro. Tasks: assessment and design of respiratory tests, participation in publications and presentations.

Dr. Gabriel Juliá Serdá. Tasks: assessment and design of respiratory tests, participation in publications and presentations.

Dr. Esteban Pérez Alonso. Tasks: participation in the design of the work, data collection and participation in the production of publications and presentations.

WORK PLAN

1. Patient recruitment and study of patients: January 2015 to December 2017.

2. Collection of data to complement the Clinical History.

Step 3. Introduction to the study. Explanation of the procedure. Signed consent form.

Step 4. Measurement of parameters:

1. Measurement of pain, Mc Gill test.
2. Measurement of respiratory parameters. Spirometry.
3. Quality of Life Measure. SF-36.
4. Measured with the Minnesota Multiphasic Personality Inventory.
5. Counting days of treatment.

Step 5. Start of the respiratory physiotherapy programme. It will be carried out in the respiratory physiotherapy unit of the University Hospital of Gran Canaria Dr. Negrín. Patients will be divided into the two groups described above and will be included in the treatment programme. The sequence for the intervention group will be as follows:

1. Explanation of the programme.
2. Placement of external analgesic measures (TENS). The frequency of application would be 100 hz as this is the type of application that produces the greatest analgesia. [10,11,12,13]
3. Implementation of the treatment regimen, for x days.
4. In the middle of the programme, measurement of all the above

parameters. Step 6. Continuation of the physiotherapy programme.

Step 7. Completion of the physiotherapy programme. Measurement of all parameters again, plus accounting of treatment days.

In the control group, the same would be done but no intensity would be given when applying TENS. The steps to follow would be the same.

ECONOMIC STUDY

Within the economic study that will define this work, we will highlight two fundamental points:

Portable spirometer brand..... 1500 Euros.

Publication of results..... 1500 Euros.

Attendance at Conferences and Scientific Conferences ..... 750 Euros.

Publication in scientific journals in the sector..... 750 Euros.

TOTAL ..... 3000 Euros.

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ANNEXES

Annex 1. Quality of Life Questionnaire SF-36

Tabla 1. Contenido de las escalas de SF-36

Dimensión	N.º de ítems	Peor puntuación	Mejor puntuación
Función física	10	Muy limitado para realizar cualquier actividad física, incluido bañarse o ducharse (origen físico)	Puede realizar todo tipo de actividades físicas, incluidas las más vigorosas, sin limitaciones
Rol físico	4	Problemas con el trabajo u otras actividades diarias (origen físico)	Ausencia de problemas con el trabajo u otras actividades físicas diarias (origen físico)
Dolor corporal	2	Dolor muy intenso y extremadamente limitante	Ningún dolor. Sin repercusión
Salud general	5	Considera mala la propia salud y cree imposible que empeore	Considera su propia salud como excelente
Vitalidad	4	Se siente cansado y exhausto continuamente	Se siente muy dinámico y enérgico continuamente
Función social	2	Su salud física o emocional no le permite, con gran frecuencia, relacionarse socialmente	Su salud física o emocional le permite relacionarse socialmente de un modo normal
Rol emocional	3	Problemas con el trabajo u otras actividades diarias (origen emocional)	Ausencia de problemas con el trabajo u otras actividades físicas diarias (origen emocional).
Salud mental	5	Sentimiento de angustia y depresión continuamente	Sentimiento de felicidad, tranquilidad y calma continuamente
Ítem de transición de salud	1	Considera su salud mucho peor ahora que hace 1 año	Considera su salud general mucho mejor ahora que hace 1 año
Total 8	36	0	100

1. Overall, you would say that your **health** is: 1 Excellent

   2 Very good 3

   Good

   4 Regular

   5 Mala

2. How would you say your **health** is **now** compared to a year ago? 1 Much better now than a year ago

   2 Slightly better now than a year ago 3

   About the same as a year ago 4 Slightly

   worse now than a year ago

   5 Much worse now than a year ago

THE FOLLOWING QUESTIONS REFER TO ACTIVITIES OR THINGS THAT YOU MIGHT DO ON A NORMAL DAY.

3. Does your current health limit you from making **strenuous efforts**, such as running, lifting heavy objects, or participating in strenuous sports? 1 Yes, it limits me a great deal.

   2 Yes, it limits me a little

   bit 3 No, it does not limit

   me at all

4. Does your current health limit you to **moderate exertion**, such as moving a table, vacuuming, bowling, or walking for more than an hour? 1 Yes, it limits me a lot.

   2 Yes, it limits me a little

   bit 3 No, it does not limit

   me at all

5. Does your current health limit your ability to **pick up or carry your shopping bag?**
1 Yes, it limits me a lot 2

Yes, it limits me

somewhat

3 No, it does not limit me at all

6. Does your current health limit your ability to **climb several flights of** stairs? 1 Yes, it limits me a lot.

2 Yes, it limits me a little

bit 3 No, it does not limit

me at all

7. Does your current health limit your ability to **climb a single flight of** stairs? 1 Yes, it limits me a lot.

2 Yes, it limits me a little

bit 3 No, it does not limit

me at all

8. Does your current health limit you from **bending or kneeling?**
1 Yes, it limits me a lot 2

Yes, it limits me

somewhat

3 No, it does not limit me at all

9. Does your current health limit you to walk **a kilometre or more**? 1 Yes, it limits me a lot

2 Yes, it limits me a bit 3

No, it does not limit me at

all

10. Does your current health limit you to walk **several blocks** (several hundred metres)? 1 Yes, it limits me a lot

2 Yes, it limits me a bit 3

No, it does not limit me at

all

11. Does your current health limit you to walk **only one block** (about 100 metres)? 1 Yes, it limits me a lot

2 Yes, it limits me a bit 3

No, it does not limit me at

all

12. Does your current health limit your ability to **bathe or dress yourself?**

1 Yes, it limits me a lot 2

Yes, it limits me

somewhat

3 No, it does not limit me at all

THE FOLLOWING QUESTIONS REFER TO PROBLEMS IN YOUR WORK OR DAILY ACTIVITIES.

13. During the last 4 weeks, did you have to **reduce the time you** spent at work or on your daily activities because of your physical health? 1 Yes

2 No

14. During the last 4 weeks, did you do **less** than you would have liked to do, because of your physical health? 1 Yes

2 No

15. During the last 4 weeks, did you have to **give up any tasks** at work or in your daily activities because of your physical health? 1 Yes

2 No

16. During the last 4 weeks, did you have **difficulty** in doing your work or daily activities (e.g., did it cost you more than usual), because of your physical health?
1 Yes

2 No

17. During the last 4 weeks, did you have to **reduce the time you** spent at work or in your daily activities because of an emotional problem?

(like being sad, depressed, or nervous?
1 Yes

2 No

18. During the last 4 weeks, did you do **less** than you would have liked to do, because of any emotional problems (such as being sad, depressed, or nervous)?
1 Yes

2 No

19. During the last 4 weeks, did you not do your work or daily activities as **carefully** as usual, because of some problem

emotional (such as being sad, depressed, or nervous)?
1 Yes

2 No

20. 20.- During the last 4 weeks, to what extent have your physical health or emotional problems hindered your usual social activities with family, friends, neighbours or other people?

Not at all

2 A little

Regular

4 Quite a lot

Very much

21. 21.- Did you have **pain** in any part of your body during the last 4 weeks?

1 No, not at all 2

Yes, very little 3

Yes, a little bit

4 Yes, moderate 5

Yes, very much

6 Yes, very much so

22. During the last 4 weeks, to what extent has the pain made it difficult for you to do your usual work (including work outside the home and housework)?

1 Nothing

2 Somewhat

3 Regular

4 Quite

5 A lot

THE FOLLOWING QUESTIONS ARE ABOUT HOW YOU HAVE BEEN FEELING AND HOW THINGS HAVE BEEN GOING FOR YOU OVER THE LAST 4 WEEKS. FOR EACH QUESTION, PLEASE ANSWER THE QUESTION THAT MOST CLOSELY RESEMBLES HOW YOU HAVE BEEN FEELING.

23. During the last 4 weeks, how much of the time did you feel full of **vitality**?

1 Always

2 Almost always 3

Often 4 Sometimes

Only ever 6

Never

24. 23.- During the last 4 weeks, how much time were you very **nervous**?

1 Always

2 Almost always 3

Many times 4

Sometimes

5 Only ever 6 Never

25. During the last 4 weeks, for how long did you feel so **low in morale** that nothing could cheer you up?

1 Always

2 Almost always 3

Often 4 Sometimes

5 Only some of the time

6 Never

26. During the last 4 weeks, how much of the time did you feel **calm and peaceful**? 1 Always

2 Almost always 3

Often 4 Sometimes

5 Only ever 6 Never

27. During the last 4 weeks, how much of the time did you have a **lot of energy**? 1 Always

2 Almost always 3

Often 4 Sometimes

5 Only ever 6 Never

28. During the last 4 weeks, how much of the time did you feel **discouraged and sad**? 1 Always

2 Almost always 3

Often 4 Sometimes

5 Only ever 6 Never

29. During the last 4 weeks, for how long have you felt **exhausted**? 1 Always

2 Almost always 3

Often 4 Sometimes

5 Only ever 6 Never

30. During the last 4 weeks, how long did you feel **happy**? 1 Always

2 Almost always 3

Often 4 Sometimes

5 Only some of the time

6 Never

31. During the last 4 weeks, for how long did you feel **tired**? 1 Always

2 Almost always 3

Often 4 Sometimes

5 Only ever 6 Never

32. During the last 4 weeks, how often has physical health or emotional problems made it difficult for you to carry out social activities (such as visiting friends or family)?

1 Always

2 Almost always 3

Sometimes

4 Only ever 5 Never

PLEASE SAY WHETHER YOU THINK **EACH** OF THE FOLLOWING STATEMENTS IS TRUE OR FALSE.

33. I think I get sick more easily than other people. 1 Absolutely true

2 Fairly certain 3

Don't know

4 Quite false

5 Completely false

34. I am as healthy as anyone else.

1 Absolutely true 2

Quite true

3 I don't know

4 Quite false

5 Completely false

35. I think my health is going to get worse.

1 Absolutely true 2

Quite true

3 I don't know

4 Quite false

5 Completely false

36. My health is excellent.

1 Absolutely true 2

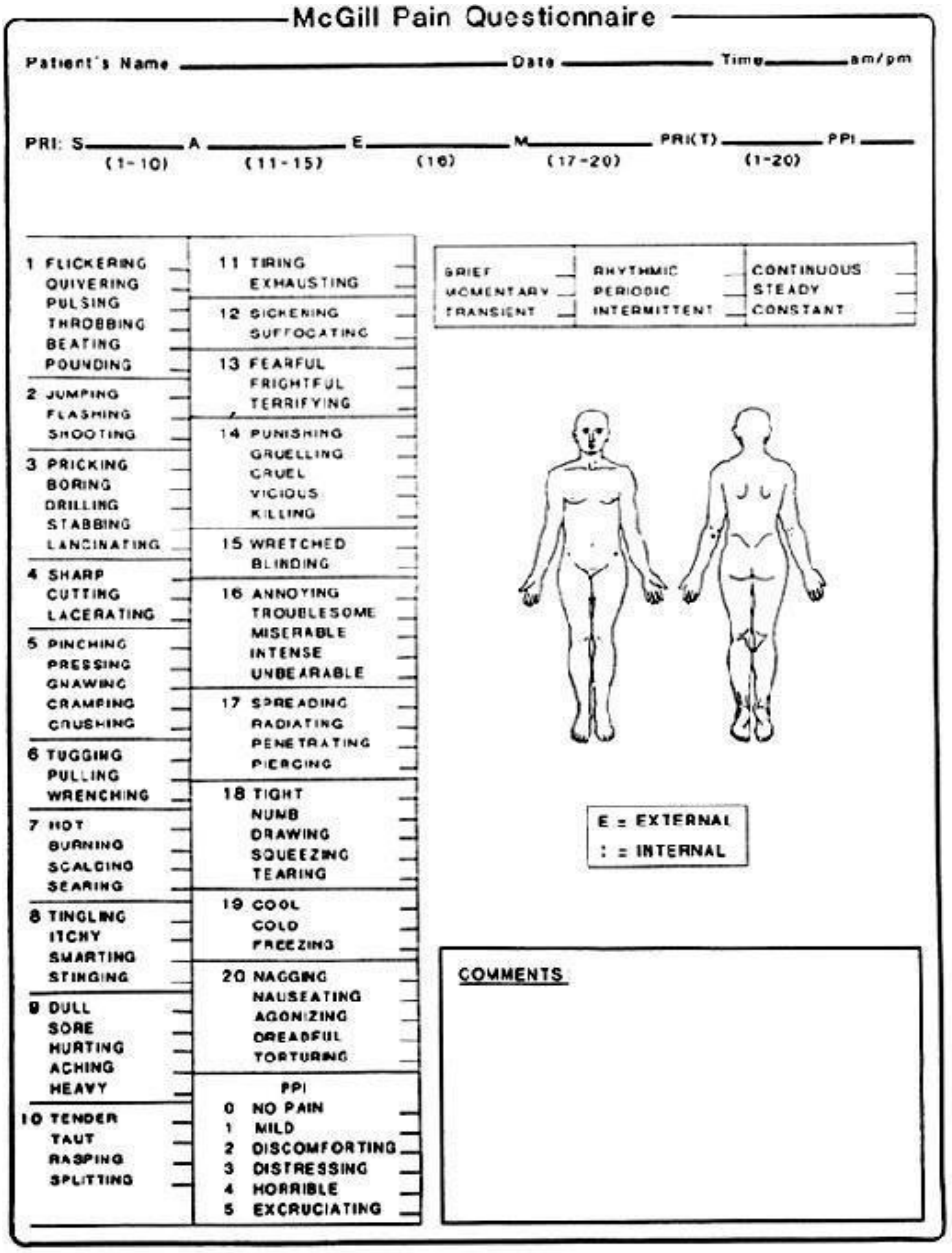
Quite true

3 I don't know

4 Quite false

5 Completely false

Annex 2. Gill's Pain Questionnaire



McGill Pain Questionnaire

Patient's Name _____ Date _____ Time _____ am/pm

PRI: S _____ A _____ E _____ M _____ PRI(T) _____ PPI _____
(1-10) (11-15) (16) (17-20) (1-20)

1 FLICKERING	11 TIRING	
QUIVERING	EXHAUSTING	
PULSING	12 SICKENING	
THROBBING	SUFFOCATING	
BEATING	13 FEARFUL	
POUNDING	FRIGHTFUL	
2 JUMPING	TERRIFYING	
FLASHING	14 PUNISHING	
SHOOTING	GRUELLING	
3 PRICKING	CRUEL	
BORING	VICIOUS	
DRILLING	KILLING	
STABBING	15 WRETCHED	
LANCINATING	BLINDING	
4 SHARP	16 ANNOYING	
CUTTING	TROUBLESOME	
LACERATING	MISERABLE	
5 PINCHING	INTENSE	
PRESSING	UNBEARABLE	
GNAWING	17 SPREADING	
CRAMPING	RADIATING	
CRUSHING	PENETRATING	
6 TUGGING	PIERCING	
PULLING	18 TIGHT	
WRENCHING	NUMB	
7 HOT	DRAWING	
BURNING	SQUEEZING	
SCALDING	TEARING	
SEARING	19 COOL	
8 TINGLING	COLD	
ITCHY	FREEZING	
SMARTING	20 NAGGING	
STINGING	NAUSEATING	
9 DULL	AGONIZING	
SORE	DREADFUL	
HURTING	TORTURING	
ACHING	PPI	
HEAVY	0 NO PAIN	
10 TENDER	1 MILD	
TAUT	2 DISCOMFORTING	
RASPING	3 DISTRESSING	
SPLITTING	4 HORRIBLE	
	5 EXCRUCIATING	

GRIEF	RHYTHMIC	CONTINUOUS
MOMENTARY	PERIODIC	STEADY
TRANSIENT	INTERMITTENT	CONSTANT

E = EXTERNAL
I = INTERNAL

COMMENTS