

# Protocol proposal for comatose patients after suffering a severe traumatic brain injury

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*Introduction: A systematic bibliographic search was performed to determine which were the best alternatives for the recovery of the comatose patient after suffering a severe traumatic brain injury in its acute context between one to six weeks after the traumatic event. Methodology: The search employed major databases (Pubmed, Embase, Ovid and Cochrane) searches to discern which therapies are the most conducive to an optimal neurocognitive improvement of the patient. This paper will delve into sensory stimulation, the different guidelines collected about its clinical application, the reason for its effectiveness, the best types of stimulation, and the habituation phenomenon. Results: The field corresponds to that of multimodal sensory stimulation: on the one hand, the use of sensory stimulation by relatives, which is shown as certainly effective; and, on the other hand, the implementation of sessions in which the hospital staff intervenes, and that stimulates the different senses. Based on certain studies, the existence of a significant positive effect of combining both therapies will be deduced and verified. This synergistic therapeutic combination can be protocolized and implemented in any hospital. Conclusions: Therefore, a definitive therapeutic treatment for clinically stable patients who have suffered a severe TBI in an acute context will be presented. It must be stressed that the main objective of the proposal is to provide guidelines based on clinical experiences about how to perform different types of stimulation to obtain a positive result.*

*Keywords: traumatic brain injury; awakening of coma; multi-modal stimulation; coma stimulation program; family sensory stimulation; habituation.*

## Introduction

Based on a systematic review of the bibliography on coma-arousal therapies after suffering a severe traumatic brain injury (TBI) in its acute context after one to six weeks, a series of clinical practice proposals were analyzed by professionals of the Hospital Universitario de San Juan de Alicante (University Hospital of San Juan de Alicante) and the Hospital Univer-

sitario General de Alicante (University General Hospital of Alicante). In this study, due to length limitations, only the latest of them will be addressed, which combines family-led stimulation and healthcare-staff-led multi-modal stimulation. This will allow us to define a therapeutic protocol. The objectives of the proposal will focus on determining its application to the clinical practice and in providing a description.

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## Material and methods

A preliminary search was performed in the main search engines (Pubmed, Embase, Ovid and Cochrane) to identify therapeutic options of sensory stimulation (SS) for a patient who has suffered a severe TBI, and a systematic bibliographic review was completed in order to find relevant documents. The keywords were “therapy”, “coma arousal”, and “brain injury”. Some articles identified as reviews were also considered. The dates of publication of the quoted articles go from 1994 to 2016. No more articles on this topic were found after that period. The research led to a proposal submitted to the medical staff of the Hospital Universitario de Alicante, with whom the possibilities and limitations of SS were discussed.

## Results

Sosnowski and Ustik<sup>1</sup> propose that SS can promote brain recovery, as it arouses the reticular activating system (RSA); Davis and White<sup>2</sup> state that this is caused by the neuroplasticity phenomenon: neural adaptive capacity, in this case, restorative. The different modes of stimulation are: auditive, olfactory, visual, gustatory, tactile and kinesthetic<sup>2</sup>. Auditive stimulation can only be effectively achieved in a quiet environment, to prevent an answer or a habituation situation<sup>3,4</sup>. The name of the patient will be used when talking to them.

In olfactory stimulation, the healthcare professional can use adequate aromatic stimulants, which may include coffee or tea, or the favorite perfume of the patient, for no more than 10 seconds.<sup>2,5,6</sup> Another stimulation mode is visual stimulation, which may work more effectively after using auditive stimulation, because the patient has just been oriented. At the beginning, the nurse of the intensive care unit (ICU) can only use a flashlight to check the change of size of the pupils as an answer<sup>6</sup>. Gustatory stimulation is used to arouse the sense of taste and produce several different responses. The ICU nursing staff may place different flavors, such as sweet, sour, salty, or bitter, on the tongue with a cotton swab<sup>2,6</sup>. Tactile stimulation focuses on stimulating the sense of touch through the perceptive functions, pressure and temperature<sup>5,6</sup>.

Tactile stimulation can be achieved by touching the patient's hand. Kinesthetic stimulation is a way of promoting conscience of one self and balance by manipulating the movement of the body<sup>5</sup>. This mode of stimulation can be limited to range-of-motion exercises, such as changing the position of the patient, for instance, by moving the patient from decubitus position to inclining them so that they are sitted<sup>2,5</sup>.

Megha, Harpreet, and Nayeem<sup>7</sup> concluded that the stimulation of the five sensory systems through at least two five-day/full-week sessions and for a minimum of two weeks increased the level of consciousness of the participants, as measured in the coma scale of Glasgow (GCS). The studies proved that regular repetition of multimodal stimulation of the first stages after the injury were useful in increasing levels of consciousness, especially if the stimuli were associated to past experiences and preferences of the individual<sup>8</sup>. Due to this, all relatives should be interviewed about the liking and preferences of the patient in order to customize and adequate the stimulation program to them. In this way, professionals could equal or improve upon the sensory effectiveness of relatives.

## Discussion

In patients with SS, a positive tendency towards recovery of consciousness was observed<sup>9</sup>. It is also important to point out that the most effective SS is that produced by relatives<sup>10</sup>, because of the high stimulation caused by sensory input related to experiences or emotional bonds. Furthermore, only clinically stable acute patients could benefit from this technique<sup>9</sup>. Therefore, a practice protocol is proposed for acute comatose patients (first weeks after severe traumatic brain injury) who will be subjected to SS, specifically that provided by relatives once or twice a day, at morning and at night, for one to six weeks. Besides receiving the SS mentioned, the patient will be subjected to multimodal SS, in order to evaluate which stimuli are most adequate for the patient in each particular case. The combination of both types of SS opens the possibility of a synergistic effect between the SS produced by relatives and that by hospital staff.

Tavangar et al.<sup>11</sup> show that, in the case re-

latives where could not stimulate the patient with their presence and voice, recordings could be used twice a day, each session from five to fifteen minutes, with an MP3 recording of the voice of family members, for one to six weeks. In a maximum of six weeks after treatment, the result will be determined, expressed as the scoring difference of the GCS from the start to the moment of evaluation, in order to decide whether another therapy is required. This article will not review other therapies, as it is focused on a more chronic context.

A fact that must be kept in mind is the contribution from Megha et al.<sup>7</sup>, who conclude that a high frequency of brief SS sessions is more beneficial than longer sessions with lower frequency. Because of this, relatives should be advised that their interventions in front of the patient should not last too long. In this way, the habituation phenomenon can be prevented, which occurs when a great number of stimuli “bombard” the patient and inhibit any type of behavioral response, which can be counter-productive and even harmful. Relatives could try to stimulate the patient by talking to them actively, using their names, visiting them in sessions of 15-30 minutes (variable duration) once or twice a day, besides establishing physical contact not only to stimulate them acoustically, but also tactilely<sup>12</sup>. The most significant changes found in the bibliography reviewed are those caused by tactile and acoustic stimulation, which resulted mainly in responses based on head and eye movement.

For this reason, within multi-modal stimulation, tactile and acoustic stimuli seem to be the more effective and the ones used in the first stages of stimulation, followed by the other types of stimulation. Furthermore, to prevent habituation, Wood<sup>13</sup> suggests limiting television and radio (i.e., any type of background noise), including clinical environment (loud voices, telephone ringing, etc.) Uninterrupted sleep/rest periods of at least 35-40 minutes per session must be allowed<sup>2</sup>. Sleep/rest periods must not be interrupted by nursing activities, because the patients will need this time to recover from the structured sensory sessions.

There is no preferred order in which to present stimulation; however, it must be done in an organized and slow manner, leaving enough

time for a response to occur<sup>5,6</sup>. The number of structured sessions, registered in a SS schedule, will vary in a day of twelve hours, which will depend on available staff. As the coma stimulation program (CSP) progresses, Sosnowski and Ustik<sup>1</sup> state that re-evaluation efforts should be implemented weekly, and that ineffective stimuli or those whose response is not positive should be discarded.

Going back to the study of Megha et al.<sup>7</sup>, Urbenjaphol et al.<sup>14</sup> also present similar results. It can be deduced that the increase in the number of brief multimodal stimulation sessions will produce a result significantly more effective than a stimulation program with a lower number of sessions: therefore, it is possible to predict that family SS combined with hospital staff multimodal stimulation will lead to a better recovery simply because the number of sessions is higher. Based on this, combined treatment could be more successful than the other option, which solves the problem previously mentioned about the combined effect. However, the main objective is not to prove the significant synergistic effect of a combined treatment, but to analyze and describe the best way to implement a stimulation program, which has not been sufficiently described in medical literature. The aim of this is to establish some precedents and foundations for other professionals to follow in order to provide the patient with the best possible CEP.

A very important fact is that this clinical practice protocol proposal was submitted to the Hospital Universitario de Alicante, because they have a neurosurgery service and, therefore, they have a number of patients who can be subjected to the different activities mentioned. It should be performed in a coordinated manner and with the cooperation of two departments: ICU and neurosurgery. Once the patient is clinically stable and it is confirmed that they have not recovered consciousness, the treatment can begin. At first, the SS will be provided in the ICU, but after a while, if the patient does not wake up, they will be taken to the neurosurgery service, where the therapeutic program can continue. The only problem of this proposal is to find a high number of available associates, nurses and/or residents to provide the stimulation sessions to the patient in the ICU and in the

service of neurosurgery.

The combination of family and healthcare staff multi-modal SS will be implemented as definitive therapy due to a series of factors, such as the possibility of using it in any hospital. A great advantage is that it does not present any type of negative effect, so in no case will it be harmful or risky for the patient, unlike other therapies, such as drug-based ones, which may have adverse effects. It is also important to consider that its application does not pose any ethical conflicts nor any other type of conflicts to professionals. This customized medicine is characterized by the selection of particular stimuli; relatives not only approve the treatment, but also participate in it. Another element to be considered is the economic cost: the combined SS therapy does not require devices or drugs to be provided by the hospital, which always translate into a health expense. These characteristics were not present in the rest of treatments or mentioned in other studies, but are necessary to establish a clinical protocol, which has not yet been accomplished.

### Conclusions

The more promising, less expensive, and invasive group of treatments during the acute phase, are encompassed within the SS. Because to this, the implementation of a clinical protocol that combines family and hospital staff SS is required. This proposal's greatest problem is to coordinate a significant number of available staff to provide stimulation sessions to the patient. However, this is an obstacle that could be resolved in a hospital with more available staff willing to participate in the proposal.

Healthcare professionals should also record their experiences and perform studies concerning the stimulation modes used (duration, frequency and tolerance) and the behavioral responses obtained (whether they be favorable or not), as well as the results of the patients in relation to the timeline (from injury, throughout the program, until the desired result is achieved). The development of structured sensory regulation programs is highly needed in health care today to establish a definitive therapeutic stimulation protocol for acute comatose patients who have suffered a severe TBI, which would be customized for the needs of each patient.

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