



# Investigation of the Effect of Hypnotic Anesthesia on Nerve Conduction Velocity (NCV)

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## Abstract

**Background:** Hypnosis is a psychological method used for treatment of different types of disorders and illnesses. This technique is also used in surgical interventions. Many studies proved the efficacy of hypnosis in medical treatment. However, the mechanism of hypnosis is unclear for scientists. To find out if the peripheral nervous system has a role in hypnotic anesthesia, we aimed to investigate the effect of hypnotic anesthesia on nerve conduction velocity (NCV).

**Methods:** In this study, healthy volunteers with high hypnotizability entered the study. First, The NCV test was performed in both hands of participants and then they all underwent hypnosis. Hypnotic anesthesia was induced in the right hand of all subjects followed by painful stimuli in their hand by vascular clamping. Then, the NCV test was repeated in both hands again. Data were analyzed by SPSS version 16.

**Results:** The group study consisted of 13 (65%) women and 7 (35%) men with their age ranging between 14 to 52 years. According to the results, the mean values of sensory latency, and NCV changed from 3.225 ms and 54.355 m/s before hypnotic anesthesia to 3.32 ms and 55.3 m/s after hypnotic anesthesia in right hand, respectively. Results showed that there was a significant difference between data before and after hypnotic induction ( $P < 0.001$ ). The covariance test also indicated a significant difference between the data obtained from both hands ( $P < 0.001$ ).

**Conclusions:** In contrast to our hypothesis, the NCV test showed an increase after the hypnotic anesthesia. However, increase in NCV did not lead to experience pain after the painful stimuli. It seems that central nervous system should be involved in this process.

**Keywords:** Nerve Conduction Velocity, Hypnosis, anesthesia

## 1. Background

Hypnosis is a psychological technique used for the treatment of various kinds of disorders and illnesses including phobias, depression, anorexia nervosa, psychologic disorders, obesity, somatization disorders, and so on. This technique can be managed easily and applied fast (1). It is used a lot for pain relief in patients by hypnotherapists (2, 3). Conventional approaches to control and manage pain are medications, surgical intervention, and physiotherapy (4). The benefit of hypnosis to relieve pain and other outstanding advantages including less complication and cost-effectiveness lead to the application of this tech-

nique in surgical operations (5-7). Surgical operation under hypnosis was first reported by James Esdaile (2). This approach is very applicable in patients who have an allergy to chemical anesthesia.

The efficacy of hypnosis has been assessed and proved in subjects related to pain perception and tolerance; however, the neural mechanisms of hypnosis remain unknown. Several studies investigated the effect of hypnosis on brain activity by imaging; however, no consistent correlation was found between the results. In other words, a clear distinction was not observed in brain activity of cases induced by hypnosis compared to those without hypnotic induction (8). It is believed that brain areas and other

structures including the insula, peripheral nervous system, spinal cords and other parts of the central nervous system may cause us to experience pain. Interruption in one of these regions may lead to eliminate pain (9, 10). It is claimed that hypnosis can influence this process. The purpose of this study was to determine how hypnosis affects the neural system. To reach this aim, we decided to investigate the impact of hypnotic anesthesia on nerve conduction velocity (NCV) by electromyography (EMG). However, no studies reveal how hypnosis affects the neural system by NCV test.

## 2. Methods

This study was a pilot and non-randomized before and after study. The study was approved in the clinical trial registry with code number TCTR20180405002. A total of 20 participants were admitted to the study according to the inclusion and exclusion criteria. Those participants were eligible to attend if they were healthy and had no psychiatric disorders and have high hypnotizability. Informed consent form was obtained from all subjects. Those who have diabetes, thyroid disease, Carpal tunnel syndrome, and contraindication of hypnosis, including psychosis (schizophrenia), major depression with tendency to suicide, some of pathological personality disorder, and paranoid disorders (11) were historically considered as not suitable cases for induction of hypnosis and were excluded from the study. Another exclusion criterion was the unwillingness to participate. After the approval of the study by the Ethical Committee of Mashhad University of Medical Sciences, the study population underwent an eye roll test for hypnotizability. A total of 20 subjects with high hypnotizability were selected for the study. After the study population was selected, the subjects were asked to refer to the physical medicine center of Imam Reza hospital. At first, the NCV test was performed in both hands of all participants then underwent hypnosis. After that, hypnotic anesthesia was induced in the right hand of all subjects. To induce hypnotic anesthesia, eye fixation, and verbal suggestion technique was used. The given suggestion was the image of dipping the hand in the snow. The right hand of subjects numbed under hypnotic anesthesia underwent painful stimuli by cardiovascular claspings. Repeatedly, the NCV test was performed in both hands of participants. At the end stage, the results of the NCV test were interpreted by a specialist of physical medicine. The SPSS 16 was used to analyze data. Kolmogorov Smirnov test and descriptive methods were used to calculate the normal distribution of data.

## 3. Results

The investigation of demographic characteristics showed that the group consisted of 13 (65%) women and 7 (35%) men with an age range of 14 to 52 years. Mean age of participants was  $29.15 \pm 9.93$  years. In all cases, NCV and sensory latency measure time were calculated before and after hypnotic induction in both hands. Regarding the sensory latency, the data revealed that the mean value was 3.225 ms before hypnotic induction in the right hand. After hypnotic induction, this value was evaluated 3.25 ms. Table 1 shows the data calculated for the sensory latency in the right and left hands.

Table 2 showed the maximum, minimum, mean, and standard deviation of sensory NCV before and after hypnotic induction. In the right and left hands, NCV before hypnotic induction were determined 54.355 and 55.695 m/s, respectively. These values were 55.3 and 56.625 m/s after hypnotic induction. The statistical analysis showed a significant difference between the obtained data before and after hypnosis ( $P < 0.001$ ), Table 2. According to the result of paired sample statistics, there was a significant difference between the data obtained before and after hypnosis in both hands ( $P < 0.001$ ). ANCOVA test also revealed a significant difference between the data obtained from both hands ( $P < 0.001$ ) (Tables 1 and 2).

## 4. Discussion

The present study was aimed to investigate the effect of the hypnotic intervention in NCV. It is unclear for scientists how hypnosis affects the neural system. During hypnosis, hypnotherapist focused the attention of subjects to an induction then a suggestion is given. The hypnosis format may greatly vary based on the induction length and type of given suggestion. In this study, the given suggestion was dipping the hand in the snow. A study conducted by Algafty and George showed that cryotherapy led to increase pain threshold and pain tolerance, which associated with significant reduction in NCV. Many authors believed that pain relief with cryotherapy might be due to the change in NCV (12). However in our study, hypnotic anesthesia did not reduce NCV, conversely, there was an increase in NCV. However, increase in NCV did not lead to pain sensation in participants. The peripheral nervous system was not blocked in our study, thus, it can be concluded that central nervous system may interfere the mechanism of hypnosis. Other research demonstrated that supraspinal central nervous system areas including brain and brain stem process the information that comes from nerve receptors of the area injured. Other parts of the brain involved in processing the information from the injured area are the thala-

**Table 1.** Sensory Latency Values Before and After Hypnosis

	Minimum	Maximum	Mean $\pm$ Standard Deviation	Median	Statistical Link Between Data Before and After Hypnosis	Statistical Link Between Data of Both Hands
<b>Sensory latency value before hypnosis</b>					< 0.001	< 0.0001
Right hand	2.8	3.8	3.225 $\pm$ 0.25726	3.2		
Left hand	2.6	3.6	3.175 $\pm$ 0.26730	3.15		
<b>Sensory latency value after hypnosis</b>					< 0.001	< 0.0001
Right hand	2.8	3.9	3.25 $\pm$ 0.3348	3.2		
Left hand	2.7	4.2	3.2350 $\pm$ 0.36168	3.15		
Left hand	2.7	3.9	3.245 $\pm$ 0.33791	3.20		

**Table 2.** NCV Values Before and After Hypnosis

	Minimum	Maximum	Mean $\pm$ Standard Deviation	Median	Statistical Link Between Data Before and After Hypnosis (P Value)	Statistical Link Between Data of Both Hands (P Value)
<b>Sensory NCV value before hypnosis</b>					< 0.001	< 0.0001
Right hand	42.60	64.5	54.355 $\pm$ 6.50299	54.850		
Left hand	45.5	66.70	55.6950 $\pm$ 5.54403	54.100		
<b>Sensory NCV value after hypnosis</b>					< 0.001	< 0.0001
Right hand	44.40	66.70	55.30 $\pm$ 6.36743	55.850		
Left hand	40.80	64.30	56.6250 $\pm$ 6.07600	57.450		

mus (13), prefrontal cortex (14), the anterior cingulate cortex (ACC), the primary (S1) and secondary (S2) somatosensory cortices, as well as the insula (15). Blockage in each part of the process may lead to eliminate pain (16). Zeev-Wolf et al. studied brain activities in regions that hypnotic anesthesia was induced and used magnetoencephalography to investigate and localize brain responses. Based on the results, less brain activity was delivered from these regions in comparison with other regions (17). It seems that hypnotic anesthesia may affect the central nervous systems.

#### 4.1. Limitations and Suggestions

Due to the application of painful stimuli, this study just evaluated cases with high hypnotizability. However, it is suggested to investigate cases with low hypnotizability in the future studies. In this study, the volume size was small, which may affect our result. Increase in sample size may lead to more reliable results. We also suggest that future studies investigate the mechanism of hypnosis by concurrent application of EEG (Electroencephalography) and EMG (Electromyography). Consideration of sex and age distribution is another suggestion.

#### 4.2. Conclusions

The attractive point of our result was the increase of NCV under hypnosis. Although the NCV increased, it did not lead to experience pain after the painful stimuli. It seems that the central nervous system should be involved in this process. It is suggested to use techniques like event-related potential or evoked potential to investigate the effect of hypnotic anesthesia on central nervous system.

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