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Hypnotic modulation of flow-mediated endothelial response to mental stress

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Abstract

Post-ischaemic flow mediated dilation of peripheral arteries (FMD) is transiently reduced during mental stress. This experiment was aimed at assessing whether hypnosis, which is a powerful relaxation technique, modulated the FMD response to mental stress in subjects with different hypnotic susceptibility. Results showed that hypnotic relaxation prevented the expected stress-related reduction of FMD only in highly hypnotizable subjects, suggesting a protective role of hypnotisability against vascular damage.

Keywords: Hypnosis; Relaxation; Mental stress; Endothelial function; Heart rate; Humans

1. Introduction

Neutral hypnosis, which is a hypnotic state without any specific suggestion, is commonly used as a technique to induce the classical "relaxation response" (Benson et al., 1981). It has been widely investigated and many autonomic (De Benedittis et al., 1994; De Pascalis et al., 1998; Harris et al., 1993; Ray et al., 2000; Santarcangelo et al., 1992; Sturgis and Coe, 1990) and somatomotor correlates have been described (Field et al., 1996; Aschan et al., 1962; Santarcangelo et al., 1989, 2003a).

Specific suggestions administered to hypnotized individuals can lead to particular cognitive-emotional experiences with characteristic physiological patterns. In particular, hypnotic suggestions of self-generated (Crawford et al., 1996; De Pascalis et al., 1987, 1998) or guided emotion have been associated with modulations of electroencephalographic and autonomic activity different from those observed in awake hypnotizable subjects. In particular, while awake subjects susceptible to hypnosis can buffer the effects of an unpleasant stimulation concerning heart, breath

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and skin resistance (Sebastiani et al., 2003b), hypnotized ones cannot suppress the autonomic output associated with such stimulation and are forced into a stereotyped response at the specific request of the hypnotist, even if their patterns indicated a balance between hypnotic relaxation and hypnotically induced suggestion-dependent stress (Sebastiani et al., 2003a).

In healthy subjects, the peripheral vascular endothelial function, which can be evaluated non-invasively as post-ischaemic flow-mediated vasodilation (FMD) by brachial artery ultrasound, has been proven to be transiently reduced by acute mental stress (Ghiadoni et al., 2000). This stress-related reduction of FMD has been attributed to an acute accumulation of endogenous catecholamines and endothelin-1 (Ghiadoni et al., 2000; Mangiafico et al., 2002; Spieker et al., 2002) and is greatly attenuated in awake highly hypnotizable persons compared with subjects not susceptible to hypnosis (Santarcangelo et al., 2003b). The aim of the present experiment was to investigate whether hypnotic induction further modulates the acute effects of mental stress.

2. Methods

2.1. Subjects

Seventeen healthy volunteers (7 females, 10 males, age 19–35) were selected according to their hypnotic susceptibility through the Stanford Hypnotic Susceptibility Scale, form C (Weitzenhoffer and Hilgard, 1962) among 97 participants. They had signed an informed consent to the experimental procedure excluding any drug administration approved by the local Ethics Committee (Pisa University).

Subjects were divided into two groups: 8 high (Highs, score 9–12/12) and 9 low hypnotizable individuals (Lows, score 0–2/12). None of them reported cardiovascular risk factors (family history of premature coronary artery disease, systemic hypertension, diabetes mellitus, hypercholesterolemia, smoking) or history of a regular practice of relaxation techniques. All had a normal resting echocardiogram.

2.2. Procedures

Experimental sessions were undertaken between 9:00 and 11:00 a.m., at least 4 h after the last meal, in a semi-darkened, sound-attenuated and temperature-controlled room (20–25 °C), with subjects in a semi-reclined position. Two experimenters were sitting nearby. All sessions were preceded by a 10-min period, not included in the study, to obtain the stabilization of autonomic parameters and the familiarization of subjects with the experimental setting. The recording session (Fig. 1) consisted of four periods: (1) a baseline (PRE, 10 min), without any specific instruction, with open eyes; (2) a neutral hypnosis (NH, 10 min) following a standard hypnotic induction (Weitzenhoffer and Hilgard, 1962), with eyes closed; (3) a period (MS, 5 min) including a mental stress of 2 min duration at its beginning, with eyes closed; (4) a later post-stress period (LATE, 10 min), with open eyes, after a standard awakening procedure (Weitzenhoffer and Hilgard, 1962). During NH no suggestion was given, except relaxation. MS consisted of serial subtraction and multiplication. In order to induce a higher level of stress subjects were falsely told that the results of their computation would be compared to FMD values to evaluate their logical-attentive capabilities.

2.3. Cardiovascular measures

In each period, heart rate (HR), artery diameter and brachial artery flow-mediated dilation (FMD) were measured. HR was derived from the peripheral ECG lead I displayed in the echo monitor while FMD was measured from 2D ultrasound

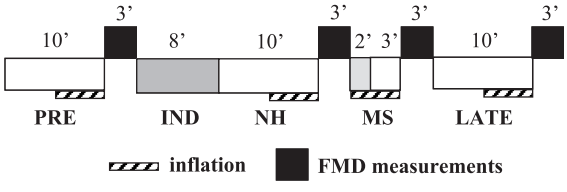

Fig. 1. Protocol flow diagram. Inflation and endothelial function (FMD) measurements corresponding to baseline (PRE), neutral hypnosis (NH) following hypnotic induction (IND), mental stress (MS) and post-stress (LATE) conditions are represented. The duration of each condition is indicated (min). Mental computation was performed during the first 2 min (grey box) of MS.