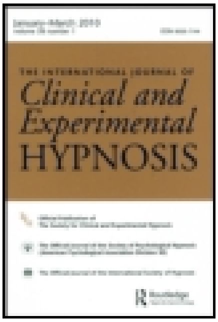

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Autonomic Changes During Hypnosis: A Heart Rate Variability Power Spectrum Analysis as a Marker of Sympatho-Vagal Balance

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AUTONOMIC CHANGES DURING HYPNOSIS: *A Heart Rate Variability Power Spectrum Analysis as a Marker of Sympatho-Vagal Balance*

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Abstract: Spectral analysis of beat-to-beat variability in electrocardiography is a simple, noninvasive method to analyze sympatho-vagal interaction. The electrocardiogram is analyzed by means of an automatic, autoregressive modeling algorithm that provides a quantitative estimate of R-R interval variability by the computation of power spectral density. Two major peaks are recognizable in this specter: a low-frequency peak (LF, –0.1 Hz), related to the overall autonomic activity (ortho + parasympathetic) and a high-frequency peak (HF, –0.25 Hz), representative of the vagal activity. The LF/HF ratio is an index of the sympatho-vagal interaction. This technique was applied, using a computer-assisted electrocardiograph, to 10 healthy volunteers (6 high and 4 low hypnotizable subjects as determined by the Stanford Hypnotic Susceptibility Scale, Form C) in randomized awake and neutral hypnosis conditions. Preliminary results indicated that hypnosis affects heart rate variability, shifting the balance of the sympatho-vagal interaction toward an enhanced parasympathetic activity, concomitant with a reduction of the sympathetic tone. A positive correlation between hypnotic susceptibility and autonomic responsiveness during hypnosis was also found, with high hypnotizable subjects showing a trend toward a greater increase of vagal efferent activity than did low hypnotizables.

An imbalance of the autonomic nervous system (ANS) and particularly the prevalence of the sympathetic nervous system is considered a conditioning factor in several pathophysiological conditions, such as mental stress (Cerutti, Fortis, Liberati, Baselli, & Pagani, 1988), physical

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training (Pagani et al., 1988), arterial hypertension or heart failure (Malliani, Pagani, Lombardi, & Rimoldi, 1991). Conversely, meditation and hypnosis have been generally considered conditions, which are characterized by a reduced sympathetic tone and an enhanced parasympathetic activity, or physiological states that are comparable to the relaxation response (Benson, Arns, & Hoffman, 1981; Gellhorn & Kiely, 1972; Wallrath & Hamilton, 1975).

Physiological investigations of hypnosis (Barber & Hahn, 1963; Bauer & McCanne, 1980; Crasilneck & Hall, 1960; Morse, Martin, Furst, & Dubin, 1977; Wallrath & Hamilton, 1975) showed that this state is associated, at least in part, with decreased heart rate, respiratory rate, and blood pressure, suggesting an involvement of the autonomic nervous system (ANS) and, in particular, the parasympathetic nervous system.

Yet, despite the relevance of this research area, previous studies have been inconclusive, as the ANS has proved to be rather elusive for study purposes in dynamic conditions because of the inadequate sensitivity of the most frequently used tools and the various interactions between the two efferent systems (Benson et al., 1981).

The human heart at rest shows spontaneous fluctuations. In particular, beat-to-beat values of heart rate are the effects of the complex regulating mechanisms that result from a combination of neural, mechanical, humoral, and other factors.

During the past 20 years, the investigation of these changes in the variability of signals has seen a significant expansion in physiological research (Akselrod et al., 1981; Pagani et al., 1986; Kitney & Rompelman, 1987) and has provided important information about the functioning of such mechanisms in pathophysiological conditions (e.g., physical training, mental stress, cardiology, neurology, diabetology, etc.) (Cerutti et al., 1988; Pagani et al., 1988).

Heart rate fluctuations are likely to reflect the continuous influence of the ANS on the natural pacemaker of the heart (Akselrod et al., 1981; Malliani, Lombardi, & Pagani, 1986). These are usually studied on the basis of a so-called heart rate variability (HRV) signal (Kitney & Rompelman, 1987). In recent years the possibility of quantifying rhythmic fluctuations by using computer techniques, particularly of R-R interval, has aroused a growing interest.

Spectral analysis of beat-to-beat variability in ECG is a simple, noninvasive method to analyze sympatho-vagal interaction (Malliani, Lombardi, Pagani, & Cerutti, 1990). In normal subjects, spectral analysis of heart rate variability showed two major rhythms: (a) a low frequency component (LF), approximatively within 0.03 and 0.15 Hz; and (b) a high frequency component (HF), within 0.18 and 0.35 Hz. The LF component has been used as a marker of sympathetic activity, whereas vagal outflow appears to modulate the HF component (Akselrod et al., 1981; Malliani et al., 1986; Pomeranz et al., 1985).

We report the preliminary results of spectral analysis of HRV performed in normal subjects during waking condition and neutral hypnosis so as to differentially assess autonomic function in both states.

MATERIAL AND METHOD

Subjects

Ten healthy volunteers (5 males, 5 females) participated in the study. Their mean age was 29.6 years (*SD* ± 5.2 years).

Subjects were selected from a larger sample of 19 volunteers on the basis of a near-maximum score (high hypnotizable subjects) and of a near-minimum score (low hypnotizable subjects) on the Stanford Hypnotic Susceptibility Scale, Form C (SHSS:C; Weitzenhoffer & Hilgard, 1962). Six subjects (4 males, 2 females) were high hypnotizables (mean score: 9.8; range 8-12), whereas 4 (1 male, 3 females) were low hypnotizables (mean score: 2.5; range 0-4).

No sign of organic or systemic disease (in particular, cardiovascular) was found in any subject. Subjects were instructed to avoid medications, smoking, and beverages containing alcohol or caffeine during the 24 hours preceding the study.

Experimental Design

A within-subject design was adopted, with each subject tested across conditions as his or her own control. Each subject participated in two sessions, at 1-week intervals, with the following conditions given in a randomized order: waking baseline (at rest) and neutral hypnosis.

The analysis of data was made by independent investigators who were blind to experimental conditions.

Apparatus and Procedure

Spectral analysis of HRV surface electrocardiogram was detected in two standard leads, using a computer-assisted electrocardiograph. Respiration was recorded with an impedantiometric technique using a thoracic belt. For each subject, the ECG and respiration were recorded concurrently during the following randomized conditions: waking, breathing at a free frequency (lying position at rest); and neutral hypnosis, breathing at a free frequency (lying position). Each episode lasted 10 minutes.

Some precautions were taken during both experimental conditions (particularly during the hypnotic procedure) to avoid controlled respiration, such as metronome breathing (e.g., enhancing spontaneous breathing during waking or avoiding direct suggestions of synchronized breathing during hypnosis), which is known to influence the vagal modulation of heart rate (Pagani et al., 1986).

After appropriate analog to digital conversion, a computer program recognized individual consecutive R wave peaks by means of a derivative-threshold algorithm with parabolic interpolation (Baselli & Cerutti, 1985) and stored them in the memory as a tachogram.

From the tachogram, simple statistics, such as mean and variance, were computed, and, subsequently, power spectral density (PSD) analysis was used to assess the hidden rhythmicity of the signal.

Various algorithms can be used at this stage, particularly the Fast Fourier Transform (FFT) or an autoregressive approach (AR). The AR approach was used for this study because it provides better spectral resolution (i.e., better identification of spectral components) and enables spectral decomposition with automatic identification of LF and HF components (Akselrod et al., 1981). It is a parametric spectral analysis, whose underlying principle is the modeling of the data by means of say, an autoregressive model (Pagani et al., 1986). The power spectrum was then divided into a sum of spectral components using a spectral decomposition method based on the residual integration (Zetterberg, 1969).

Data Analysis

ECG and respiration recorded signals were simultaneously transmitted via infrared light to a Toshiba 3.200 personal computer. Subsequently, off-line analysis was performed. Signals were digitized at 400 samples/second per channel. Stationary sections of data of appropriate length were selected for analysis. The computer program first calculates the interval tachogram, that is, the series of N consecutive R-R intervals. From sections of tachogram of 512 interval values, simple statistics (mean and variance) of the data are computed. As an example, for an average heart rate of about 70 beats/minute, 512 successive R-R intervals would amount to approximatively 7.5 minutes. The computer program automatically calculates the autoregressive coefficients necessary to define the power spectral density (PSD) estimate. It also calculates the power and frequency of every spectral component. Each spectral component is presented in absolute units as well as in normalized form, by dividing it by the total power less the DC component, if present.

The collected time series were analyzed to obtain variability indexes both in time and frequency domain. Time domain analysis provided the mean value of R-R intervals (RR) for each period; the standard deviation of R-R interval time series (SD), which is an index of total HRV (Kleiger, Miller, Krone, & Bigger, 1990); and the coefficient of variance (CV) or normalized SD, that is, the ratio SD/RR, which could represent the component of HRV independently from heart rate.

HRV analysis in frequency domain provided a low-frequency component (LF) approximatively within 0.03 and 0.15 Hz; a high-frequency component (HF) within 0.18 and 0.35 Hz, which contained the respiratory peak in all subjects (HF has been used as a marker of vagal activity, whereas both vagal and sympathetic outflows modulate LF); LF and HF component power, expressed by the area and measured in normalized units (i.e., nu), which are obtained by dividing the power of a given component by the total variance and multiplying by 100 (Pagani et al., 1986); and LF/HF ratio, which can be considered as a marker of sympatho-vagal balance and, in fact, increases during sympathetic and decreases during vagal stimulation. In the resting human subject, the power of the LF component of R-R variability is greater than that of the HF component, with a ratio usually > 1 (Pagani et al., 1986).

The following procedures were used for statistical analysis: frequency calculations including arithmetic mean, median, standard deviation (*SD*), median deviation (*MD*), and standard error (*SE*); and differences between and within groups of dependent variables were analyzed by the Wilcoxon-Signed Rank (two-tailed) test (pairwise comparisons) and by two-way ANOVA (Friedman test) (multiple comparisons). Significant effects were further analyzed using the Newman-Keuls post hoc test.

Hypnosis

A standard hypnotic procedure was devised for this investigation. Neutral hypnosis was defined as "the state initiated by a traditional induction before the time of suggestion" (Benson et al., 1981). In brief, the procedure involved the following: elicit cooperation, progressive relaxation, and arousal.

The hypnotic induction was designed to maximize both the relaxation and the imagery component of a standard hypnotic procedure. The relaxation component was derived from the SHSS:C and from Progressive Relaxation Training (Bernstein & Borkovec, 1973), with instructions to relax specific muscle groups and emphasis on the deepness of the relaxed state. The imagery component was derived from imagery conditioning (Kroger & Fetzler, 1976) and used aspects of body relaxation with emphasis involving all five senses in the relaxing imagery. The induction was stripped of any suggestion of synchronized breathing and ended with a simple countdown procedure including awakening instructions.

Evaluation of hypnotic behavior and arousal were convergently made by subjects' verbal report of trance (subjectively rating the "depth" of hypnosis on a 0-10 scale) and by an independent observer.

RESULTS

Time Domain

Table 1 summarizes HRV data from time domain analysis. Hypnosis significantly increased R-R intervals, as compared with waking, but only

Table 1
Effects of Neutral Hypnosis on the R-R Interval and the Coefficient of Variance (CV) (group means and SD*)*

Subjects	Condition	RR (msec)	CV ($msec^2$)
Total sample	Waking	720 ± 111	1819 ± 1619
	Hypnosis	798 ± 116	2965 ± 2702***
Low hypnotizables	Waking	714 ± 95	1820 ± 2042
	Hypnosis	757 ± 103	2585 ± 1980**
High hypnotizables	Waking	734 ± 121	1793 ± 1614
	Hypnosis	825 ± 125*	3200 ± 3242****

*$p < .05$; **$p < .02$; ***$p < .01$; ****$p < .001$.

in the highly hypnotizable subjects (waking-RR 734 ± 121 msec vs. hypnosis-RR 825 ± 125 msec, $p < .05$); *SD* did not significantly change in either highs or lows.

CV was significantly greater in hypnosis than in the waking state (CV-waking 1819 ± 1691 $msec^2$ vs. CV-hypnosis 2965 ± 2702 $msec^2$, $p < .01$). Hypnosis increased variance significantly in lows (CV-waking 1820 ± 2042 $msec^2$ vs. CV-hypnosis 2585 ± 1980 $msec^2$, $p < .02$), and even more in highs (CV-waking 1793 ± 1614 $msec^2$ vs. CV-hypnosis 3200 ± 3242 $msec^2$ $p < .005$).

The effects of hypnotizability on dependent variables (waking, hypnosis) were analyzed in a 2 (Hypnotizability Level) × 2 (Waking, Hypnosis) ANOVA (Friedman test). The analysis of CV yielded a significant effect for hypnotizability, $F = 10.81$, $df = 3$, $p < .02$. The post hoc test revealed that the high hypnotizables generated higher variance than did the low hypnotizables ($p < .05$).

Frequency Domain

Table 2 shows HRV data from AR spectral analysis, namely, power spectrum density (PSD) of LF and HF components (mean values ± *SE*), as well as LF/HF ratio (median values ± *MD*), during waking and neutral hypnosis, for the total sample and in high and low hypnotizable subjects.

For the total sample, hypnosis significantly decreased the median LF/HF ratio from 2.47 to 1.13, or –54% ($p < .01$) as compared with the waking condition, which demonstrates a shift toward a parasympathetic control of HRV during trance.

When analyzing the sample according to hypnotic susceptibility, high hypnotizables' hypnosis provoked a statistically significant reduction of the median LF/HF ratio (from 2.46 to 0.89, or –64%, $p < .005$), showing a quasi-symmetry of the sympatho-vagal balance, whereas a sympathetic predominant tone is usually present in the waking state. The median LF/HF ratio decreased less in the low hypnotizables (from 2.55

Table 2
Effects of Neutral Hypnosis on the R-R Interval Variability (LF & HF spectral components: group means and SE*) (LF/HF ratio: median and* MD*)*

Subjects	Conditions	LF normalized power	HF normalized power	LF/HF ratio
Total sample	Waking	39.3 ± 3.8	22.5 ± 4.7	2.47 ± 1.40
	Hypnosis	50.1 ± 7.6	25.9 ± 2.9	1.13 ± 0.71**
Low hypnotizables	Waking	39.5 ± 0.8	19.0 ± 4.0	2.55 ± 0.99
	Hypnosis	53.1 ± 6.8	29.9 ± 2.9	1.28 ± 0.14*
High hypnotizables	Waking	33.4 ± 2.7	26.1 ± 5.7	2.46 ± 1.01
	Hypnosis	39.9 ± 8.5	26.1 ± 2.7	0.89 ± 0.45***

$^*p < .01$; $^{**}p < .02$; $^{***}p < .004$.

to 1.28, or −50%, $p < .02$). Differences related to hypnotizability on LF/HF ratio approached statistical significance ($p < .06$).

No significant divergence between measures of hypnotic state during the experimental manipulations by subjects' hypnotic depth subjective rating scale or by the independent observer was ever reported (i.e., all the highs showed more hypnotic behavior than did the lows during the experimental conditions).

Figure 1 shows the PSD of a highly hypnotizable subject in two different episodes: resting control condition and neutral hypnosis. Hypnosis significantly reduced sympathetic activity (LF component), producing a shift in power distribution in favor of the HF (vagal) component.

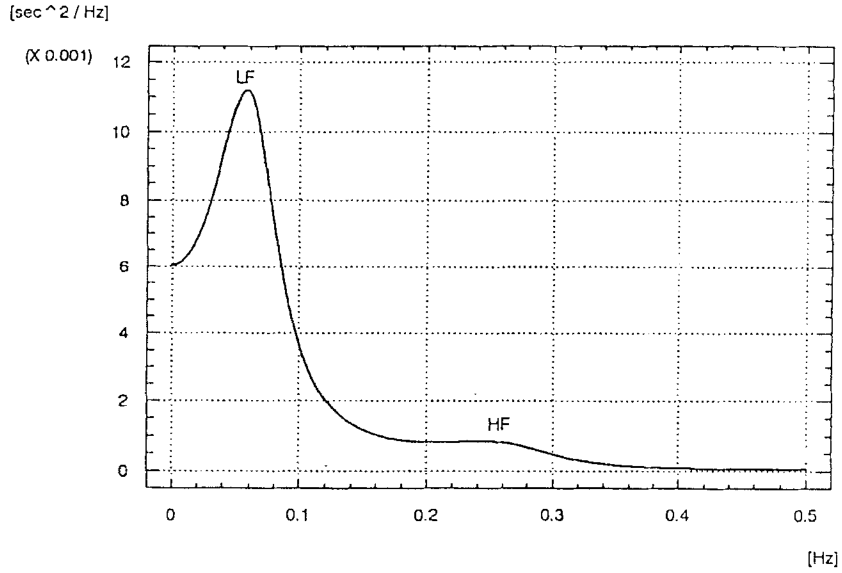
DISCUSSION

The hypothesis that hypnosis, particularly neutral hypnosis, might be associated with a reduced sympathetic tone and an enhanced parasympathetic activity, as suggested by earlier studies (Barber & Hahn, 1963; Crasilneck & Hall, 1960; Morse et al., 1977; Wallrath & Hamilton, 1975), has received further support from our investigation employing spectral analysis of R-R interval variability.

The ANS is conceived as a pure outflow (Langley, 1903). The output of such a complex system can be simplified in a "sympatho-vagal balance," thus reflecting long-known evidence, namely, that the excitation of either outflow is accompanied by the inhibition of the other in a sort of push-pull organization, at least in most physiological conditions.

Because cardiovascular function is the most tried and tested index of stress arousal in both experimental and clinical psychophysiology (Sinatra & Freitel, 1985), it could also be an important factor in defining a so-called autonomic profile, and describing the dynamic process of the ANS in controlling the cardiovascular system over time and in response to the different demands of daily life.

Waking



Hypnosis

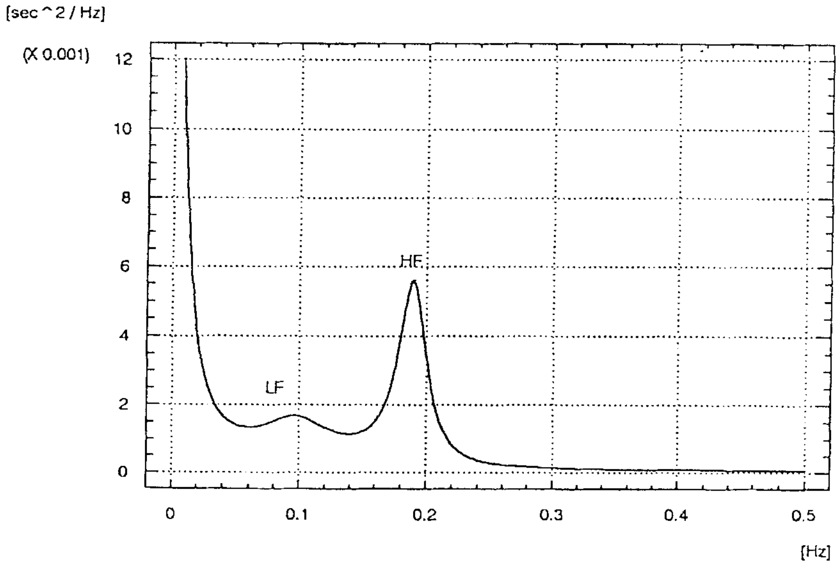


Figure 1. **Power spectrum density (PSD) of a highly hypnotizable subject in resting waking condition (top) and neutral hypnosis (bottom). Hypnosis significantly reduced sympathetic activity (LF component), producing a shift in power distribution in favor of the HF (vagal-parasympathetic) component.**

The PSD analysis of the HRV represents a noninvasive, sensitive, and potentially useful tool for the assessment of the autonomic function (the so-called autonomic profile) in discrete states of consciousness, such as hypnosis.

In normal subjects, spectral analysis of HRV shows two major rhythms: a low-frequency component (LF), approximatively within 0.03 and 0.15 Hz; and a high-frequency component (HF), within 0.18 and 0.35 Hz.

The HF component is synchronous with the respiration and has been considered as a quantitative assessment of respiratory arrhythmia (Pomeranz et al., 1985). Vagal efferent activity has been interpreted as being primarily responsible for the HF component on the basis of experiments on vagotomized decerebrated cats (Chess, Tam, & Calaresu, 1975), conscious dogs (Akselrod et al., 1981), and humans with muscarinic receptor blockade (Pomeranz et al., 1985).

The interpretation of the LF component appears more complex, with this part of the spectrum likely reflecting both sympathetic and vagal activities in addition to baroceptive, thermoregulatory, and humoral mechanisms (Akselrod et al., 1981). However, recent evidence shows that, on the whole, LF should be considered as a marker of sympathetic excitation, regardless of the mechanisms through which such excitation occurs (Malliani et al., 1991).

Therefore, the HF component has been used as a marker of vagal activity, whereas, on the whole, sympathetic activity appears to modulate the LF component, so that the LF/HF ratio can be considered a marker of sympatho-vagal balance (Pagani et al., 1986).

Our preliminary results showed that hypnosis affects HRV, shifting the balance of the sympatho-vagal interaction toward a relative reduction of the sympathetic dominance and/or a parasympathetic hyperactivity.

In particular, neutral hypnosis augmented R-R intervals (i.e., decreased heart rate), confirming data from the literature (Barber & Hahn, 1963; Bauer & McCanne, 1980; Crasilneck & Hall, 1960; Morse et al., 1977; Sturgis & Coe, 1990; Wallrath & Hamilton, 1975). During hypnosis, an increase of R-R coefficient of variance (CV) was also recorded, which has been generally considered a condition in which vagal modulation of heart period is greatly enhanced (Malliani et al., 1991).

Furthermore, in our study, neutral hypnosis was associated with a significant decrease ($p < .01$) of the LF/HF ratio as compared with the waking, resting condition. Because the LF/HF ratio is commonly accepted as a reliable marker of the sympatho-vagal balance, it was concluded that hypnosis enhances the parasympathetic tone, concurrently reducing the sympathetic activity.

During hypnosis, high hypnotizables increased the vagal efferent activity ($p < .005$) more than did low hypnotizables ($p < .02$), as compared with the corresponding waking condition. The difference approached statistical significance ($p < .06$). The apparent discrepancy between the mean values for LF and HF power and the LF/HF ratio might be explained by considering that the LF/HF ratio represents the median of the LF/HF ratio of single subjects (i.e., the central tendency) and may not necessarily be equal to the ratio of the means of the LF and HF power. Moreover, a certain scatter in the data might account, at least in part, for this finding. On the whole, however, in line with Sturgis and Coe (1990), high hypnotizables tended to show a greater degree of physiological, autonomic responsiveness than low hypnotizables with regard to heart rate levels. Finally, the fact that increased CV and lower LF/HF ratio were observed in both high and low hypnotizables during the hypnotic condition might be explained by thinking of hypnosis as a *continuum*. As a consequence, the relationship between hypnotizability and the autonomic response is not a perfect, dichotomic correspondence but rather a probabilistic one, with a greater probability of successful parasympathetic shift for those highly responsive to hypnosis.

In sum, the present results support the notion that the relaxation response, spontaneously observed in neutral hypnosis and in other discrete states of consciousness, is likely to be associated with a functional reorganization of the autonomic balance, in terms of parasympathetic hyperactivity and/or reduced sympathetic tone.

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Autonome Veränderungen während der Hypnose: Eine Herzrate "Power Spektrum"-Analyse als Markierung der sympathiko-vagal Balance

Giuseppe DeBenedittis, Mario Cigada, Anna Bianchi, Maria G. Signorini, und Sergio Cerutti

Abstrakt: Spektralanalyse der Herzschlag-zu Herzschlagveränderung in Elektrokardiographie ist eine einfach, nicht angreifende Methode, um die sympa-

thiko-vagal Interaktion zu analysieren. Die Analyse des Elektrokardiogramms findet mittels eines automatischen, autoregressiv modellierenden Algorhythmus statt, der eine quantitative Schätzung der R-R-Intervallsveränderung durch Komputation der "power spectral density" verschafft. Zwei Hauptspitzen sind in diesem Spektrum erkennbar: eine schwache Frequenzspitze (LF, -0.1 HZ), in Verbindung mit der gesamten Autonomieaktivität stehend (ortho + parasympathisch) und eine hohe Frequenzspitze (HF, -0.25 HZ), die vagale Aktivität repräsentierend. Die LF/HF-Ratio ist ein Index der sympathiko-vagal Interaktion. Diese Technik, mit Hilfe einer komputerunterstützten Elektrokardiographie, wurde bei 10 gesunden Voluntären (6 hoch und 4 schwach hypnotiserbare, an der Stanfordhypnoseempfindlichkeitsskala, Form C gemessen) in planlosen Wach- und Neutralhypnosekonditionen angewandt. Vorläufige Resultate deuten darauf hin, daß Hypnose die Veränderlichkeit der Herzrate beeinflußt, indem sie die Balance der sympathiko-vagal Interaktion auf eine verstärkte, parasympathische Aktivität verschiebt, verbunden mit einer Reduktion des gleichgestimmten Tons. Man fand auch eine positive Korrelation zwischen Hypnoseempfindlichkeit und autonomer Reaktion während der Hypnose, wo hypnotisierbare Subjekte eine Neigung zu höherer Steigerung der vagalen Efferenzaktivität zeigten als die schwach hypnotisierbaren.

Changement du système végétatif durant l'hypnose: puissance de l'analyse spectrale de la fréquence cardiaque comme marqueur de l'équilibre sympathico-vagale

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Résumé: L'analyse spectrale de la variabilité de l'intervalle interbattement dans l'electrocardiogramme est une méthode simple et non-invasive pour analyser l'interaction sympathico-vagale. L'électrocardiogramme est analysé de façon automatique grâce à un modèle algorythmique auto-régréssif qui donne un estimé quantitatif de la variabilité de l'intervalle R-R calculé par la densité du spectre de puissance. Deux crêtes majeures sont reconnaissables dans ce spectre: une crête de basse fréquence (BF, -0.1 Hz) reliée à l'activité autonomique totale (ortho et parasympathique) et une crête de haute fréquence (HF, -0.25 Hz) caractéristique de l'activité vagale. Le ratio BF/HF est un index de l'interaction sympathico-vagale. Cette technique a été employée, à l'aide d'un électrocardiographe assisté par ordinateur, sur 10 sujets volontaires en bonne santé (6 fortement hypnotisable et 4 faiblement hypnotisable selon l'Échelle de Suggestibilité Hypnotique de Stanford, forme C) dans des conditions randomisées d'hypnose éveillée et neutre. Les résultats préliminaires indiquent que l'hypnose affecte la variabilité de la fréquence cardiaque déplaçant l'équilibre de l'interaction sympathico-vagale vers une augmentation de l'activité parasympathique tout en réduisant celle de l'activité sympathique. Une corrélation positive entre la suggestibilité à l'hypnose et la sensibilité du système sympathique indique pour les sujets fortement suggestibles une tendance vers une plus grande augmentation de l'activité vagale efférente comparativement aux sujets peu suggestibles.

Cambios autónomos durante la hipnosis: análisis del poder de la tasa cardíaca como un marcador del balance simpático-vagal

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Resumen: El análisis espectral de la variabilidad del latido cardíaco en la electrocardiografía es un método simple, no agresivo, para analizar la interacción simpático-vagal. El electrocardiograma es analizado por medio de un modelo algorítmico autoregresivo automático, el que provee una estimación cuantitativa de la variabilidad del intervalo R-R por el cálculo de la densidad del poder espectral. En este espectro se reconocen dos extremos mayores: un extremo de baja frecuencia (LF, –0.1 Hz), relacionado con la actividad autonómica total (orto + parasimpatica) y un extremo de alta frecuencia (HF, –0.25 Hz), representativo de la actividad vagal. Esta técnica fue aplicada, usando un electrocardiógrafo computarizado, a 10 voluntarios en buen estado de salud (6 sujetos de alta sugestibilidad y 4 de baja sugestibilidad medidos por la Stanford Hypnotic Susceptibility Scale, Form C) en condiciones aleatorias de vigilia o de hipnósis inactiva. Los resultados preliminares indicaron que la hipnósis afecta la tasa de variación del ritmo cardíaco, cambiando el balance de la interacción simpático-vagal hacia una actividad parasimpática acrecentada, concomitante con una reducción del tomo simpático. Se encontró también una correlación positiva entre sugestibilidad hipnótica y respuesta autonómica durante la hipnosis; los sujetos altamente hipnotizables mostraron tendencia hacia un mayor aumento de la actividad vagal eferente, comparados con los de baja hipnotizabilidad.