Effects of Rub and Touch on Emotions and Respiration in Humans

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Abstract: Touch therapy is important in many clinical settings to reduce patient stress and anxiety. However, few studies have examined the effects of touch therapies, particularly those that use specific techniques to ease psychological and physiological distress, on the emotional state of patients. Respiratory rate is correlated with emotional changes. Thus, the aim of the present study was to elucidate the effects of touching and rubbing methods on various respiratory parameters as indices of the emotional state in 11 normal, healthy subjects. Subjects were divided into high and low anxiety groups based on their State-Trait Anxiety Inventory (STAI) score before the experiment. After the application of specific touching and rubbing stimuli, the subjects were asked to evaluate their comfort level on a visual analog scale. The respiratory rate in subjects with high anxiety increased significantly more during rubbing than touching; in contrast, the respiratory rate in subjects with low anxiety did not differ between the two methods. As a whole, the data suggest that touch rather than rub therapy may be more suitable for subjects with high anxiety, and that the therapeutic technique to be used should be chosen with care for subjects with high anxiety.

Key words: rub, touch, respiration, anxiety, visual analog scale

Introduction

In recent years, touch therapy has been increasingly used in various clinical settings to reduce stress and/or pain¹. Touch therapy constitutes an especially important aspect of nursing practice. In clinical practice, touch therapy reportedly reduces stress, promotes relaxation, and enhances general well being in patients. Therapeutic touch also significantly reduces anxiety in patients with cardiovascular disease².

Although many reports have shown that touch or touching has a large effect on patients’ anxiety or stress, few studies have examined the effect of touching on physiological and psychological responses. In the literature, there are two types of touch: one is a procedural or instrumental touch, which is used for rehabilitation purposes³, whereas the other type of touch is characterized by the intent to care for or comfort the patient and is referred to as “comfort

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The primary aim of comfort touch is to ease psychological and physiological distress and to communicate with the patient. Comfort touching involves non-moving touch, rubbing, and, to a lesser extent, holding and patting forms of contact with the patient’s arms, hands, or thighs.

There is reportedly a strong relationship between emotion and breathing. Respiration is regulated by a control system in the brain stem related to metabolic demands, but is influenced by behavior and the state of arousal. Conditioning processes in the environment may also affect breathing. Previous studies on personality differences in patterns of breathing during mental stress and a physical load test found that levels of individual anxiety affect respiratory frequency. Furthermore, previous psychophysiological studies have investigated the relationships between emotion and increases in heart rate, blood pressure, and respiration. Increases in the respiratory rate (RR) during anxiety have been shown to be correlated with the degree of trait anxiety.

To observe the simple effect of touching on psychological and physiological responses, and to address the two types of touch mentioned above, we examined the effects of touch and rubbing using psychological scales and respiratory responses, which were used as objective indices of the emotional state in normal subjects. Specifically, in the present study we investigated whether the emotional state induced by simple stimuli, namely touching and rubbing, can change RR, tidal volume (VT), minute ventilation (VE), and end-tidal carbon dioxide concentration (ETCO₂) in normal, healthy subjects.

**Methods**

**Subjects**

Eleven healthy adults participated in the present study (mean ±SD age 37.2 ± 10.1 years; five women, six men). The study was approved by the Ethics Committee of Showa University School of Nursing and Rehabilitation Sciences. All subjects provided informed consent before participating in the study.

**Psychological measurements**

Before the experiment, subjects’ anxiety levels were assessed using the State-Trait Anxiety Inventory (STAI). This instrument comprises two scales with 20 statements each that measure either state or trait anxiety. The trait anxiety scale is used to evaluate how people feel generally; the state scale is used to evaluate how people feel in various situations. The state scores may change depending on the situation, whereas the trait scores are generally stable.

After each touching stimulus (described below), subjects were asked to assess their sense of comfort using a visual analogue scale (VAS). The VAS consisted of a 10-cm horizontal line, with the extreme left defined as “extremely uncomfortable” and the extreme right defined as “extremely comfortable”. It has been suggested that a VAS is more appropriate for the measurement of feelings than a category scale.
Respiration measurements

Participants wore a face mask connected to a transducer and flowmeter (Minato Medical Science, Osaka, Japan). The respiratory flowmeter was used to measure $\dot{V}_E$, $V_T$, RR, total respiratory time, inspiratory time, and expiratory time. ETCO$_2$ levels were monitored continuously using a gas analyzer (CO$_2$: 5.0%) during each test. All data were recorded using an analog-to-digital converter (PowerLab/16SP; AD Instruments, Bella Vista, NSW, Australia) installed on a laptop computer (VAIO VGN-SR91NSA; Sony, Tokyo, Japan).

Touching techniques

Touch stimuli were administered by a certified nurse. Two touching techniques were used consistently throughout each session, namely comfort touch (touch) and moving hands (rub), with each delivered in a specifically timed sequence.

During the touch technique, the participant’s left hand was placed on the nurse’s left hand, and the nurse’s right hand gently covered the participant’s left hand. For the rub technique, the participant’s left hand was placed on the nurse’s right hand, and the nurse’s right hand gently rubbed the back of the subject’s left hand. The rub stimulation was delivered once every 2 s between the wrist and the fingertips.

Experimental protocol

The experiment was conducted in the laboratory of the Department of Physiology, Showa University School of Medicine. After providing informed consent, each participant completed the STAI questionnaire. Participants sat on a comfortable reclining chair and placed their left hand on the table beside them. A tube (1-mm diameter) connected to the gas analyzer was set below the subject’s nose for measurement of ETCO$_2$. The participant wore a face mask for measurement of other respiratory parameters. A certified nurse sat on a chair to the left of the participant. Touch and rub stimuli were delivered three times for 1 min each with a rest interval of 4 min. Participants were asked to describe their emotional state using the VAS scale. During the rest interval, all respiratory parameters were monitored and confirmed to have returned to baseline levels before the next stimulus was delivered.

Emotional and respiratory analysis

All statistical analyses were performed using a commercially available statistical package (SPSS Version 18.00; SPSS, Tokyo, Japan). Ventilation responses during rest, during each stimulation (touch or rub), and after the stimuli had been delivered were analyzed by two-way repeated-measures analysis of variance (ANOVA) to test for within-factor (rub or touch and time) variance.

For repeated analysis, the time of stimulus delivery was divided into five categories: pre-rest period (1 min), first half of the stimulation period (30 s), second half of the stimulation period (30 s), post-rest period (1 min), and the second post-rest period (1 min).

Subjects were divided into two groups based on STAI scores: (i) those with high anxiety;
and (ii) those with low anxiety. The median state anxiety score for all subjects was 39; thus, the high anxiety state was defined as a state anxiety score $\geq$39, and the low anxiety state was defined as a state anxiety score $< 39$. The mean $\pm$SD age of subjects in the high and low anxiety groups was 33.3$\pm$7.4 and 41.8$\pm$11.9 years, respectively ($P'NS$). Similarly, there were no significant differences in the gender distribution between the high (three men, three women) and low (three men, two women) anxiety groups.

Differences in RR responses during rub and touch stimulation between the high and low anxiety groups were analyzed by one-way ANOVA. Dunnett’s test was used for within-factor comparisons (the state anxiety score of the high and low anxiety groups, and stimuli). Differences in VAS scores for rub and touch stimuli (i.e. VAS_{touch} - VAS_{rub}) between the high and low anxiety groups were analyzed by the Wilcoxon rank-sum test to test for within-factor comparisons.

**Results**

There was no significant effect of the interaction between stimulus (rub/touch) and period (rest/stimulation) on $\dot{V}_E$ ($P = 0.151$), but there was a significant difference in $\dot{V}_E$ between the rub and touch stimuli, particularly during the first half of stimulus delivery ($P = 0.046$; Fig. 1).

There was significant effect of the interaction between stimulus (rub/touch) and period (rest/stimulation) on RR ($P = 0.004$), as well as a significant difference in RR between the rub and touch stimuli during the first and second stimulation periods ($P = 0.043$ and $P = 0.0006$, respectively). RR increased during rub stimulation more than during touch stimulation. During rub stimulation, the second stimulus significantly increased RR compared with that recorded during the rest period ($P = 0.003$; Fig. 1).
Rub and Touch Affect Emotions and Respiration

There was no significant effect of the interaction between stimulus (rub/touch) and period (rest/stimulation) on VT (Fig. 1). The VT response to the rub and touch stimuli was identical.

RR and state anxiety
As described above, subjects were divided into high and low anxiety groups, and increases in RR during the rub and touch stimuli were compared between the two groups. As shown in Fig. 2, RR in the high anxiety group was significantly greater during the rub stimulus than during the touch stimulus in both the high (P < 0.05) and low (P < 0.01) anxiety groups. There was a significant difference in RR following rub and touch stimulation between the high and low anxiety groups (P < 0.01). Data are the mean ± SD. *P < 0.05, **P < 0.01.

There was no significant effect of the interaction between stimulus (rub/touch) and period (rest/stimulation) on VT (Fig. 1). The VT response to the rub and touch stimuli was identical.

RR and state anxiety
As described above, subjects were divided into high and low anxiety groups, and increases in RR during the rub and touch stimuli were compared between the two groups. As shown in Fig. 2, RR in the high anxiety group was significantly greater during the rub stimulus than during the touch stimulus in both the high (P = 0.044) and low (P = 0.004) anxiety groups.

VAS and state anxiety
Because RR during the touch stimulus was significantly lower than that during the rub stimulus in the high anxiety group, we investigated differences in perceived levels of comfort following rub and touch stimuli in the high and low anxiety groups. Differences in VAS scores (i.e. VAS\text{touch} - VAS\text{rub}) were compared between the high and low anxiety groups. There was a significantly lower VAS score for comfort level following rub stimulation (tending towards “unpleasant”) in the high compared with low anxiety group (P = 0.045; Fig. 3).

Discussion
Increase in RR in subjects with high anxiety
Because RR may be an index for evaluating the emotional state\(^6\), we investigated whether somatosensory stimulation using touch or rub stimuli causes respiratory changes indicative of comfort or relaxation. In addition, we examined differences in individual responses between
subjects with high and low anxiety states.

As a whole, RR increased during the rub stimulus compared with that during the touch stimulus, with no change in V_T. The slight increase in V_E observed in the present study may have been caused by the increase in RR. It has been reported that RR increases during anxiety. In addition, this increase in RR depends on an individual’s anxiety level. Therefore, we divided subjects into high and low anxiety groups. As indicated in Fig. 2, the increase in RR during the rub stimulus was significantly greater than that during the touch stimulus in the high anxiety group; furthermore, the increase in RR during the rub stimulus in the high anxiety group was greater than that seen with either stimulus in the low anxiety group.

There are reports that negative emotions increase RR without affecting V_T. In addition to negative emotions, a high arousal state may increase RR. Conversely, decreases in RR are associated with decreased anxiety and may be linked to relaxation. From these points of view, we assume that the increase in RR during the rub stimulus in subjects with a high anxiety state was related to these subjects feeling uncomfortable and not in a relaxed state. Based on measures of the level of comfort felt by the subjects, comfort levels decreased significantly during the rub stimulus in subjects with high compared with low anxiety (Fig. 3). On the basis of these observations, we suggest that touch stimuli are more suitable for use in subjects with high anxiety.

The amygdala tends to be activated in individuals with high anxiety. The amygdala is related to anxiety and fear emotions, and so these individuals are sensitive to external stimuli. Activation of the amygdala results in a simultaneous increase in RR. For example, noxious auditory stimuli and music have been reported to increase RR in subjects with high anxiety. Interestingly, in the present study, we found that rub stimuli, which are more stimulating than touch stimuli, resulted in increased RR in subjects with high anxiety. The question then raised is
whether the increase in RR is caused by the rub stimulus itself or by an unpleasant emotion.

Respiratory responses associated with activation of the amygdala contribute to an awareness of emotional feelings\(^{13}\), and the respiratory responses may be even faster than becoming aware of ones emotions. From this viewpoint, subjects with a high anxiety state may have a tendency for increased RR following stimulation, and this response could contribute to their emotional state.

*Touch or rub stimuli: which is more effective for subjects with high anxiety?*

In contrast with subjects with high anxiety, those with low anxiety did not exhibit any differences in responses to rub and touch stimuli. Interestingly, subjects with high anxiety are quite sensitive to negative stimuli, but are also influenced by positive stimuli. There is a good correlation between respiratory responses and changes in feelings. For example, in one study, state anxiety decreased to a greater degree in subjects with high anxiety after they observed a flower arrangement compared with subjects with low anxiety\(^{15}\). This phenomenon was also observed in the present study with respect to the touch stimulus in subjects with high anxiety. We assume that for subjects with low anxiety, the method of touching (i.e. touching or rubbing) is less important than that chosen for subjects with high anxiety. Thus, the method used to administer touch therapy should be chosen carefully for subjects with high anxiety.

Bottorff\(^{16}\) classified touch into five patterns using videotape recordings of interactions between cancer patients and nurses. One of these patterns was the comfort touch, which may be performed to calm, soothe, quiet, reassure, and encourage the patient\(^{17}\). Rose\(^4\) suggested that the comfort touch slows a subject’s breathing rhythm and may be linked to the subject’s comfort and relaxation.

One important factor to take into consideration is the emotional state of the individual applying the touch therapy to the subject or patient. Breathing rhythm and emotional states tend to synchronize with those of another person\(^{19}\). It is also possible that anxiety present before the application of touch therapy will increase RR. Therefore, the emotional state of the practitioner or nurse applying the touch therapy to the patient must be relaxed, which may then slow their breathing pattern, producing an atmosphere more conducive to the patient’s relaxation.

In the present study, we evaluated emotional feelings during rub and touch stimuli using physiological assessments. Our data suggest that touch rather than rub stimuli may be more suitable for subjects with high anxiety. We did not test the effects of other touch methods on emotional and respiratory responses; these other touching methods should be evaluated in future studies. The results of the present study may be applicable to various clinical situations in hospitals and terminal care facilities, and highlight the importance of considering the anxiety levels of patients and/or subjects prior to initiating therapy.

**References**


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