Using Aroma to Reduce Distress During Magnetic Resonance Imaging

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Abstract

The research investigated the use of aroma to reduce anxiety and distress in individuals undergoing magnetic resonance imaging (MRI) during diagnostic work-up for cancer. To determine the effects of this use of aroma, fifty-seven outpatients received humidified air with heliotrope (vanilla-like scent), or humidified air alone through a small tube into their nostrils during the MRI procedure. Their levels of anxiety (as measured by scientifically validated patient rating scales) were compared. The delivery of heliotrope and air was controlled by a computer; the fragrance was presented in bursts to prevent adaptation. Patients who received heliotrope reported 63% less anxiety than patients who received air alone. Physiological measures (pulse and heart rate) were not affected by the presentation of the fragrance during the MRI.

The last five years has seen a rapid increase in the use of magnetic resonance imaging (MRI) scanning in the diagnosis of cancer and other medical problems. The MRI represents an important advance in medicine. It provides a method of "seeing" internal body structures, and thereby helps in the early detection of cancer and other diseases. It uses a harmless (and painless) magnetic field and radio waves rather than x-rays. The MRI produces extremely clear images of body structures, such as the heart, brain and other vital organs. The MRI machine is large and imposing, measuring 10 feet on all sides and housed in a shielded room. During the procedure the patient is slid into a 23 inch diameter tunnel in the center of the machine and is left alone until the scan is completed. The only contact the patient has with the MRI technician is through an intercom. Depending on the problem being studied, the scan can last over one hour. In order to obtain a clear image the patient must remain still during the entire scan.

Because of the severe restriction of movement and the confined space inside the bore, some patients are likely to report feelings of claustrophobia. "It's like being in a tomb," one patient said. This fear is often heightened for individuals
undergoing MRI in the diagnostic work-up for cancer. For them, the scan may confirm their worst fear: that they have cancer. When we surveyed 160 patients undergoing MRI at Memorial Sloan-Kettering Cancer Center, we found that for 10% of the patients the distress became so severe that the scan had to be terminated early (Brennan et al. 1988). Moreover, one-third of the patients reported experiencing severe anxiety while being scanned. Other studies have reported similarly high rates of anxiety, and the necessity to terminate the scan because of anxiety and distress. In one clinical study with MRI patients, Klonoff and his colleagues (1986) found that 20% of patients did not complete a scan because of claustrophobic reactions. In a study with general hospital patients, Kilborn and Labbe (1990) found that between 5 and 10% of patients became claustrophobic during the procedure.

In addition to patient distress caused by MRI, delays and early terminations of MRI scans add to the already high cost of the procedure. At a cost of $1,500 per scan, the average 15-minute delay that we found in cancer patients (Brennan et al. 1988) would result in a loss of $62.5 million nationwide each year. There is, without question, a need for cost effective methods to reduce patients' anxiety reactions during MRI scans. One possible strategy is the use of anti-anxiety medications. While they might be effective, many cancer patients want to avoid taking additional medications, and some are especially resistant to taking drugs that affect their mental state. Beside the subjective reasons that make anti-anxiety medications less than ideal for many patients, their use can delay scans because the drugs need time to take effect. They also cause sedation which the patient must tolerate after the scan is over. Thus, while anti-anxiety medications have been used with some individuals during MRI, their use has been quite limited and is not likely to be widely adopted to reduce distress associated with MRI scans. Another strategy for making MRI scans easier is to provide music. Music has been used in various medical settings to help reduce stress, and some patients have reported that it helps. But no scientific evidence regarding its effectiveness has been reported in the professional literature.

When we first considered the problem of how to reduce patient anxiety during MRI, we considered the practical limitations of the clinical setting and the need for method(s) that would be immediately effective and easy to implement. We thought of how our prior research on the use of behavioral relaxation and distraction to control chemotherapy side effects and pain in cancer patients might be relevant. In that work (Redd, in press; Burish & Redd, in press) we found behavioral relaxation and attentional distraction to be effective in controlling nausea and vomiting in patients undergoing chemotherapy. Patients who were trained in self-induced relaxation could effectively block the occurrence of aversive side effects. They could go into a “trance state” of deep relaxation and immediately terminate the feelings of nausea and anxiety. Our relaxation techniques are very similar to meditation and self-hypnosis. With young children we used a different strategy. Our goal was to distract the pediatric cancer patients' attention from their aversive symptoms in hopes of reducing them. The approach is simple and resembles the idea of “getting one's mind off the problem.” Attentional distraction is critical in many of the techniques used to control pain and anxiety (such as hypnosis). We found that pediatric cancer patients were far less anxious and had less nausea when they were given video games to play as they waited for their chemotherapy treatment.

Unfortunately, we could not transfer either of our methods directly to the problem of MRI anxiety. First, the adult patients who were able to use relaxation to control their chemotherapy nausea had to be trained in relaxation before they were able to control their nausea in the context of the chemotherapy clinic. Such training would be impractical for MRI patients who typically do not undergo MRI scans on a repeated basis. Second, the video game procedure would be impossible within the MRI chamber. Third, both approaches are labor intensive and ultimately infeasible.

Fortunately, Lorig and Schwartz's research (1987 [a and b]) on the effects of fragrance on
anxiety provided a suggestion of what to do. They observed reliable changes in physiological measures of arousal and anxiety when college undergraduates were presented with particular fragrances. Certain fragrances made the students less anxious. Although the "ideal" relaxing fragrance has not been identified, Lorig and Schwartz [1987b] found that presentation of a spiced apple fragrance (i.e., the smell of apple pie) produced electroencephalic (EEG), physiologic, and subjective evidence of relaxation in the students under conditions of quiet contemplation. Although the exact mechanism underlying their effects is not understood, at least four possibilities can be identified. First, certain fragrances may have certain inherent biological effects which elicit relaxation. Second, because of past experience particular fragrances may be differentially associated with relaxation, and thereby elicit what might be called "conditioned" relaxation (as with the "warm and relaxed" images associated with the smell of warm apple pie or wood burning in a fireplace). Such associated relaxation is understood in terms of Pavlovian classical conditioning (e.g., the dog who salivates when he hears the bell that in the past had been rung just before meat powder was delivered into his mouth). The fragrance elicits a conditioned relaxation response. Third, the fragrance may have served to distract the subjects from their worries and thereby resulted in anxiety reduction. And fourth, all three of the above may have been operating in combination.

Based on the research of Lorig and Schwartz, we reasoned that similar fragrance-induced relaxation effects might be achieved during MRI scans. We also reasoned that, in addition to the potential physiological effects of fragrance as an elicitor of relaxation, fragrance might serve to distract the subjects' attention from anxiety-eliciting stimuli. Our aim was quite simple: to examine the use of fragrance to reduce distress. We chose to work with individuals being screened for cancer because of their need for assistance, and the fact that such a study was feasible at our center. The specific goal was to determine if giving patients the fragrance heliotropin during the scan would help them relax and make the scan easier. Our choice of heliotropin was based on our survey of adults to determine their preference and reaction to various scents.

**Research Procedure**

The research procedure used in this study is called a randomized clinical trial: individuals are randomly assigned to a group receiving standard treatment or to a group receiving the treatment method under study. In our study, participants were individuals coming to Memorial Sloan-Kettering for MRI in their diagnostic work-up for cancer. We recruited individuals who were waiting for the MRI scan. We first explained the study, and asked them to sign a written statement of informed consent. They were then randomly assigned to the control (air alone) or experimental (aroma) group. If they did not wish to participate, they received the usual treatment.

Fifty-seven individuals participated. Eight criteria were used to select study participants. They had to: 1) be 18 to 65 years of age 2) have no prior or current chemotherapy 3) have no prior psychiatric history 4) be scheduled for outpatient treatment 5) have no history of allergic reactions to perfumes 6) have used no anti-anxiety or pain medication for the past 48 hours 7) experienced anxiety prior to the onset of the scan and 8) be able to detect the fragrance when it was presented.

Although we screened all individuals who received MRI as outpatients at Memorial Sloan-Kettering, some patients were excluded from participation for the following additional reasons: 1) they were allergic to the fragrance or refused to have a plastic tube inserted into their nose, 2) they already had their own way of controlling anxiety, or personally did not feel that they needed any help 3) they felt too nervous or nauseated to participate and wanted...
to be left alone or 4) they did not like the smell of the fragrance or thought that it would not help. The group of 57 included 26 men and 31 women and was representative of the patients seen at the Memorial Sloan-Kettering. Our sample was representative of all races and socioeconomic groups.

The fragrance was 5% synthetic heliotropin suspended in a 25% solution of odorless dipropylene glycol and odorless diethylphthalate. The odorant has a faint, sweet, vanilla-like scent. Heliotropin was selected after pilot testing of five fragrances supplied by International Flavors and Fragrances, Inc. (New York, New York). Among the 25 medical staff at the hospital in which the study was conducted, heliotropin was rated as the most relaxing, most pleasant and moderately intense fragrance.

Before the scan began the patients were unaware of the group to which they were assigned (control or experimental). During the scan, a plastic tube was placed into the patient's nostril through which stimuli (fragrance or air) were delivered. Delivery was controlled by a computerized valve so that the fragrance was presented in punctate bursts followed by non-fragranced bursts. The same schedule of delivery was followed for the control group, except only non-fragranced air was used. This procedure was designed to reduce the possibility of adaptation to fragrance.

Results and Discussion

We examined the effects of fragrance administration on several ratings of anxiety and physiologic functioning (heart rate and blood pressure) before and after the scan. In addition, behavioral measures (whether the patient requested termination of the scan before it was completed, and whether the scan was terminated prematurely) were obtained. Patients who were administered the heliotropin scent during MRI scans, and was rated the fragrance as pleasant, reported a significant decrease in average anxiety, while patients who received humidified air alone did not. The fragrance intervention was successful for the 70% of those patients who experienced heliotropin as pleasant.

There appear to be at least two factors that might account for the effects obtained in the present study. As we mentioned earlier, one possibility is cognitive distraction. Patients may have been distracted from feelings of anxiety during the scan by their associative reactions to the fragrance. The fragrance may have elicited reactions (i.e., thoughts, images, emotions, etc.) that were incompatible with sensations of anxiety. Prior research has shown that odor can help elicit moods and memories (Ehrlichman & Halper, 1988; Kraut, 1982; Stellar & Stellar, 1988). Thus, feelings of anxiety may have been blocked by the patient's reactions to the fragrance. Unfortunately, patients were not queried regarding their associations to the fragrance beyond whether or not they liked it. The distraction explanation is consistent with our prior research on the use of cognitive (i.e., visual) imagery to block anxiety and anticipatory nausea in chemotherapy patients (Redd, Andresen & Minagawa, 1982 cf., Redd et al., 1987). In that research, patients did not experience anxiety or nausea as long as they were engaged in the distracting task. As soon as they stopped engaging in the imagery, symptoms reappeared. The same processes may have been operating in this study.

The second possible mechanism is physiological relaxation in direct response to the physical properties of the fragrance. This hypothesis is consistent with the study by Lorig and Schwartz (1987, a & b). They found reductions in both physiological and psychological measures of anxiety in college volunteers exposed to apple-spice fragrance in a non-stress laboratory setting. However, in the present study we failed to obtain physiological changes in response to the fragrance. This failure to replicate may have been because we used heliotropin rather than apple-spice, or because we were unable (for technical reasons) to measure...
physiological reactions until after the scan was finished. In the Lorig and Schwartz laboratory studies, measures were obtained at the same time that the fragrance was being administered. Unfortunately, the magnetic field of the MRI chamber made such simultaneous physiological measurement impossible.

An interesting finding was the importance of the patients' subjective liking (i.e., hedonic response) to the fragrance. The benefits of fragrance administration were only apparent for the patients who found it pleasant. There are a number of possible explanations for this finding. The strength of any association (thoughts, images, emotions) may have been stronger when the fragrance was pleasant for the patient. Alternatively, patients may have used "pleasant" to mean calming and relaxing. If so, then we would predict that they would report less anxiety for the period that they were exposed to heliotropin. Another possibility is that for patients who did not rate heliotropin as pleasant, any associations (images) may have actually been negative and even served to increase anxiety.

The third set of issues to be addressed concerns the clinical use of fragrance to control anxiety during stressful medical procedures. First, were the reductions in MRI anxiety clinically important? Our data suggest a clinically significant effect: patients who received fragrance showed a 47% reduction in average anxiety whereas patients in the control condition showed a 5% reduction. Second, how might the positive impact of fragrance administration be enhanced? There are at least two approaches to improving the effectiveness of the intervention. The first would be to increase the likelihood that patients would find the fragrance pleasant and thereby show greater benefit. This could be accomplished by giving patients a choice of fragrance to be used during the scan. A second approach would be to combine fragrance administration with other anxiety reduction techniques (e.g., audiotape relaxation exercise) during the scan. Another issue is the clinical feasibility of fragrance administration during MRI scans and other stressful medical procedures. The present procedure was quite elaborate, including a computerized delivery system, separate lines for fragrance and air alone, etc. However, in a non-experimental setting where fragrance contamination and counterbalancing were critical, an easier (and less costly) system could be used. The possibility of much simpler methods of fragrance administration means that fragrance could be incorporated into routine clinical practice without great difficulty or significant expense.

Although the results must be replicated before we can recommend the routine clinical use of fragrances, the results suggest that olfactory cues may be useful in controlling anxiety and distress during stressful medical procedures.

References


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