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Can MRI related patient anxiety be prevented?

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ABSTRACT

Purpose: To evaluate the effectivity of a combined intervention of information and communication to reduce magnetic resonance imaging (MRI) anxiety using prolactin and cortisol as biochemical markers and State Trait Anxiety Inventory (STAI).

Materials and methods: This study is a randomized prospective research. Sample size was 33 patients. Fourteen patients were enrolled as study group, compared to 19 patients as control group. Blood samples were collected by venous sampling, and STAI was filled before and after scan. State anxiety inventory was used twice. Study group received a standard information about MRI scans and were communicated with 2 minute intervals via intercom; control group had no intervention. Blood samples were carried in ice to be centrifuged and stored as soon as they were taken to study prolactin and cortisol. Data were stored and analyzed by SPSS 17.0. *P* value for significance was accepted as 0.05.

Results: Prolactin-pre, prolactin-post, cortisol-pre, cortisol-post, cortisol percent increase, Trait Anxiety Inventory (TAI), SAI (State Anxiety Inventory) pre-scan and post-scan levels were similar between demographic groups. Cortisol-pre levels were similar between study and control, however prolactin-pre levels were significantly higher in control group. Study group had 6% lower cortisol level post-scan, whereas control group had 18% increase. Study and control groups had similar Trait Anxiety and SAI-pre scores. SAI-post scores were lower in study group when compared with control group. Study group also had lower SAI-post scores than SAI-pre, whereas control group had higher.

Conclusion: MRI anxiety can be reduced by information and communication. This combined method is shown to be effective and should be used during daily radiology routine.

1. Introduction

Magnetic resonance imaging (MRI) is a painless radiological tool that does not use ionizing radiation. Although MRI is considered as biologically safe and painless, patients experience claustrophobia and anxiety due to the nature of the procedure. Brennan et al. showed that 35% of patients experience some degree of anxiety during MRI scans [1]. Quirk et al. showed 37% incidence of intermediate level claustrophobia during MRI scans [2].

Anxiety is a feeling experienced by nearly everyone, which can be subjectively explained as worry or fear [3]. Anxiety is as defined by Barlow as “a future oriented mood state, in which one is ready or prepared to attempt to cope with upcoming negative events” [4]. Anxiety causes many hormonal response systems to be activated; such as sympatho–adrenomedullary axis (SAM) and hypophysis–pituitary–adrenal axis (HPA). These pathways release catecholamines and glucocorticoids as effector hormones [5]. Effector hormones in blood increase in concentration in a matter of seconds to minutes [6].

Prolactin is one of the novel stress markers. Its blood level increases in anxiety, particularly in response to acute psychosocial stressors [7]. However, prolactin and cortisol levels peak in different situations. Sobinho et al showed prolactin peaks as a result of humiliation and rage, whereas cortisol peaks due to fear and confusion [8].

During MRI, the patient lies in a narrow closed cylinder, which causes discomfort and anxiety particularly in patients with claustrophobia. It is also known that the sound of MRI and the loss of control over procedure contributes to the anxiety [9]. Katz et al pointed out that fear of pain and the expectation of test result also contributes to anxiety [10]. These contributors are sometimes so severe that patients experience their first claustrophobia attack during MRI, even without a previous condition [11].

Patients often describe their MRI experiences as “being buried alive”, “being deserted” or “left to death”. These thoughts may cause premature endings to MRI sessions or session skips by patients; causing clinical problems in short-term and economical loss in long-term [10].

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MRI anxiety and its negative effects are both well known. A study published in 2007 shows that this is a current problem: Seventy-one percent of the participants reported that anxiety was a common problem at their MRI center, and 19% stated that it disrupted scanning on a regular basis [12]. A study conducted by Dantendorfer et al. showed that 12.8% of scans had motion artifacts and 6.4% had impaired diagnostic quality [13].

A variety of preventive methods have been tried to reduce MRI anxiety such as information and relaxation exercises [14], communication during procedure [15], prone positioning [16], systemic desensitization [17], music [18], anxiolytics [19] and imaginative visualization [20]. The primary focus of this study is to show the effectiveness of a combined method of information and communication to reduce anxiety by using biophyschometric scales and biochemical markers.

2. Methods

This study is a randomized prospective research and was performed according to the World Medical Association Declaration of Helsinki, and an informed consent was obtained from all participants. The sample size was limited to 33, patient selection was limited with 5 weekdays (between 7th and 11th of February, 2011) and randomization was conducted day-wise i.e. patients undergoing MRI on odd numbered days were accepted as control group, and patients on even numbered days were accepted as study group. This method was applied to prevent study and control group patients to come into contact with each other. Fourteen patients were enrolled as study group, and 19 patients as control group. Only 2 patients refused to take part in this study; they did not accept to donate blood for this study.

Only MRI-naive patients were chosen since previous encounter with the MRI may have an impact on anxiety. A study on skydivers shows that both first timer and experienced skydivers have increased salivary cortisol levels after 15 minutes of skydiving with no significant difference between two groups [21]. A study on similar scenario with narrow spaces and disturbing sounds, flying, shows that repeated exposure via virtual reality decreases anxiety [22].

Patients were asked to fill out a demographics form (consisting of sex, age, education, marital status) and State Trait Anxiety Inventory (STAI) forms. STAI is an English form developed by Spielberger, Gorsuch and Lushene. It has 2 subdivisions, State Anxiety Inventory (SAI) measures the anxiety of a cross-section. Trait Anxiety Inventory (TAI) measures the susceptibility to anxiety (TAI: Trait Anxiety Inventory). Range of each subdivision's score can be between 20 and 80; higher scores meaning higher anxiety. SAI was used twice, SAI-pre (before the procedure) and SAI-post (after the procedure). SAI shows a cross-sectional anxiety state; it was used to measure changes in anxiety before and after scan. Two previous studies used the same method for measuring anxiety [15,23]. STAI has shown validity and reliability in its original language [24,25], and in Turkish [26].

Participants in the study group, after filling in SAI-pre and TAI parts of the form, were informed of the procedure verbally with a standardized form. Information was given by the same researcher during the study, and consisted of standard messages:

- MRI is a non-ionizing diagnostic modality; it does not use X-Rays.
- You will be asked to remove all metal belongings; we will provide you with a safe space to store them.
- You will be laid down into the scanner, and you will have to stay still for a good quality image.
- You will enter into the scanner which will feel like a tunnel, but this is not dangerous or painful. We will be in the observation room.
- You will hear knocking noises; this is not something to worry about; it is the normal function of the scanner.
- Your scan will be complete roughly in 20 minutes.

Since patients may have had different levels of comprehension, the process of giving information was only concluded when all the standard information was passed on and the patient had no questions about the scan.

After getting prepared for the procedure, the patient entered the MRI room, and the venous blood sample was taken. The MRI machine was Siemens Magnetom Symphony 1.5 T. The magnet length is 1.60 meters, and the tunnel length is 1.91 meters (Siemens Healthcare, USA, 2007). Patients in study group were contacted by the built-in intercom between each sequence (approx. 2 minutes apart) whereas control group had no contact during the procedure. After the procedure, second venous blood samples were collected, and patients were asked to fill out SAI-post. Post-procedural sampling time was 20 minutes for all participants.

Blood samples were collected by venous sampling and preserved in ice until they were delivered to the lab. Each sample was delivered to the lab—as soon as they have been taken—individually to be centrifuged. The supernatant was stored immediately. After 5 days of collection, all blood samples were analyzed for cortisol and prolactin. The analysis was done within the same day with the same calibrator kit to ensure that there will be no differences related to calibration.

Cortisol, the last and the effector hormone of hypophyisis–pituitary–adrenal (HPA) axis, is synthesized from adrenal cortex. It gives its peak in serum in response to a stimulus in 20 to 40 minutes [27]. Cortisol secretion is diurnal and has an interpersonal variability. Therefore, percent change of cortisol concentration was used to understand better its response to the stressor. Cortisol levels were studied from serum samples via an automatized electrochemiluminescence method using cortisol specific biotinylated antibody and streptavidin coated microparticles (Modular Analytics E710, Roche Diagnostics, Germany). The data provided by the manufacturer state intra-study variability coefficient as 1.1–1.3% for concentrations between 7.53 and 46 microgram/deciliters and inter-study variability coefficient as 1.6% for concentrations between 0.018 and 63.4 microgram/deciliters.

Prolactin is a protein structured hormone and released from anterior pituitary gland. It is controlled from hypothalamus by dopamine, which is an inhibitor to its release; making it unique from other pituitary hormones. Prolactin has a pulsatile release and has a half-life of 50 minutes. The secretion peak takes place during REM sleep, reaching 30 micrograms/liters [6]. Its release pattern and biochemical structure make it a state anxiety marker, increasing in seconds. Prolactin levels were studied from serum samples via an automatized electrochemiluminescence method using prolactin specific biotinylated antibody and streptavidin coated microparticles (Modular Analytics E710, Roche Diagnostics, Germany). The data provided by the manufacturer state intra-study variability coefficient as 0.8–1.1% for concentrations between 8.55 and 109 nanograms/milliliters and inter-study variability coefficient as 1.6–1.8% for concentrations between 0.047 and 470 nanograms/milliliters.

Data were stored and analyzed by SPSS 17.0. Numeric variables were analyzed with Shapiro–Wilk for normality; and either by T-tests or Mann–Whitney-U test for significance. *P* value for significance was accepted as 0.05.

3. Results

3.1. Demographics

There were 33 patients enrolled in the study. Fourteen of them were study patients; 19 were control patients. Demographic variables include age, sex, marital status and educational level (Table 1). Since the sample size was small for multiple subgroups analysis, demographic data were analyzed by grouping. Age was