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i.v. diazepam.**

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Panic Attacks During MR Imaging: Treatment with IV Diazepam

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This study includes 3000 patients undergoing MR imaging, all of them conscious, with no history of alcoholism, drug addiction, heart disease, or schizophrenia. During the course of the MR study, panic attacks occurred in 46 subjects, which prevented continuation of the examination. An IV bolus injection of diazepam was administered, which enabled completion of the examination in all 46 cases. The expected effects of a high blood level of diazepam, such as somnolence, slow reactions, overrelaxation, and inhibition of breathing, were not observed. The panic attacks disappeared rapidly after the injection. The patients agreed to a repeat MR examination under similar conditions, if necessary.

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Panic attacks occurring during the course of MR examinations may disrupt the diagnostic process as well as interrupt the routine work in the MR imaging suite. Anticipation of the panic attacks and their control facilitates the normal course of the examination.

Freud was the first to describe the syndrome of anxiety neurosis [1]. His description is similar to that described in the section for panic disorders of the *Diagnostic and Statistical Manual of Mental Disorders* [2]. Attacks with similar symptoms have also been noted earlier, in 1871, by da Costa [3] in his description of "soldier's heart." However, he believed that the disorders were cardiac rather than nervous in origin.

The idea that panic attacks indicate a distinct form of anxiety disorder was originally proposed by Klein [4, 5]. He based this claim mainly on the observation that panic attacks respond to treatment with imipramine, while a background of generalized anxiety does not similarly respond to imipramine.

Material and Methods

Three thousand patients, ages 19 to 56 years old, underwent MR examinations in a 0.5-T Elscint magnet during a period of 2 years. Other patients who were referred for MR during the same period and were not completely conscious or had a history of alcoholism, drug addiction, heart disease, or schizophrenia were not included in this study. Forty-six of the patients (29 women and 17 men) developed panic attacks 5 to 15 min after the start of the examination. A panic attack was defined in patients who developed at least four of the symptoms described in Table 1.

None of the patients were able to complete the MR examination until diazepam was administered. Thirteen of the patients tried to complete the examination on the same day, while 12 others were referred for examination several days later. They developed similar symptoms at the beginning of every repeat examination, until diazepam was injected.

All 46 patients who experienced panic attacks were encouraged to have diazepam administered intravenously before the start of a repeat MR examination. Two patients weighing less than 60 kg received 7 mg of diazepam. The remaining 44 patients, whose body

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TABLE 1: Distribution of Clinical Symptoms in Patients with Panic Reaction During MR Examination

Symptom	No. of Patients
Fear of dying, going crazy, or doing something uncontrolled	46
Hot and cold flashes	39
Palpitations	36
Chest pain	33
Faintness	33
Vertigo	31
Sweating	29
Dyspnea	26
Paresthesia of hands and/or feet	21
Nausea	18

weight ranged from 63 to 92 kg were given 10 mg of diazepam in an IV bolus, using a Venflon 21J catheter, which was left in the vein for 90 min. The MR examination started immediately after injection of the IV bolus of diazepam, under close observation by a physician positioned by the magnet tunnel, who watched the patient's breathing and conversed with him or her between the various imaging sequences. A resuscitation unit was readily available.

Results

Panic attacks were diagnosed in 46 (1.5%) of 3000 patients undergoing MR examination. In the vast majority of patients the panic attack was unexpected and even surprising. Those patients were unable to remain in the magnet tunnel for the duration of the examination, and repeat attempts to return them to the tunnel resulted in renewed symptoms.

Thirty-nine of the 46 patients experienced panic attacks for the first time in their life. The remaining seven patients had known panic or anxiety disorders. Two of these seven patients received permanent treatment with imipramine, which did not prevent panic reaction during the MR examination. The remaining five patients received premedication with sedative drugs, which did not prevent the panic attack. Another six patients with known panic disorder who were under long-term imipramine treatment, did not develop panic attacks during the MR examination. The imipramine treatment in these six patients was unrelated to the MR examination.

Following an IV bolus administration of diazepam, all 46 patients recovered rapidly, became asymptomatic, and were able to complete the MR examination. They made good contact with the attending physician, and none required resuscitation. Contrary to expectations, the patients were not somnolent, tired, or overrelaxed. They agreed to have repeat MR examinations under the same conditions.

Discussion

Many of the obvious symptoms of a panic attack reflect overactivity of the sympathetic nervous system. A panic attack can be provoked by hyperventilation, yohimbine, and other drugs with an alpha-adrenergic blocker effect.

Today it is believed that panic attacks develop when there is an abnormal balance between excitation and inhibition of the locus ceruleus, which is situated in the floor of the fourth ventricle. Stimulation of cells in the locus ceruleus in animals leads to behavior similar to that observed in panic attacks in humans. On the other hand, lesions in the locus ceruleus abolish the behavioral response to anxiety-provoking stimuli. The drugs piperoxan and yohimbine, which increase activity in the locus cells, produce anxiety-like behavior in animals [6]. Probably the high blood level of diazepam administered in an IV bolus can influence the polysynaptic connections between the locus ceruleus and higher structures in the brain, resulting in normalization of the balance between excitation and inhibition of the locus, blocking the pathologic circle that causes the panic attacks.

Clinical observations of the effects of imipramine and related antidepressants can be compared with some pharmacological findings. The immediate effect of these drugs is to block the re-uptake of noradrenaline, thereby increasing the amount of noradrenaline acting postsynaptically [7-13]. This finding correlates with the observation that some patients are extremely sensitive to imipramine, developing side effects such as insomnia, irritability, and unusual energy during the earlier stages of the treatment. The antipanic effect develops approximately 4 weeks after the treatment [14]. Long-term administration of tricyclic antidepressants reduces postsynaptic beta-adrenergic receptor function [13]. These mechanisms seem not to be well understood. However, despite the positive influence of antidepressant drugs on panic attacks, they are useless when a rapid effect during the MR examination is required. The high blood concentration of diazepam following bolus IV administration solves this problem.

Imipramine is the drug of choice in patients with panic disorder (repeated panic attacks). Diazepam is believed to be inefficient in these patients; however, there are no reports of IV injection of diazepam during a panic attack. The calmness of the patient, together with the absence of somnolence, sedation, and breathing difficulties in our patients have still not been explained.

Diazepam is contraindicated in patients with glaucoma. Injected intravenously, it has a local irritative effect, which can be diminished when the injection is performed with caution. Diazepam that is injected cautiously is known to decrease the risk of apnea. In our patients, no side effects and no drug interactions have been observed.

A disadvantage of IV administration of diazepam is that this procedure requires the physician to stay close to the patient during the MR examination. Based on recent experience not included in this study, it is hoped that the administration of a tablet of 10 mg of diazepam sublingually instead of an IV injection can avoid this disadvantage.

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