HISTOPATHOLOGICAL ANALYSIS OF THERMAL CHANGES OF THE PARAVERTEBRAL SOFT TISSUE DUE TO MRI AFTER ANTERIOR TITANIUM PLATE APPLICATION*

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ABSTRACT:

Evaluation of the thermal effects of MRI was planned after diagnosing aortic aneurism in a patient who had severe abdominal pain after postoperative MRI evaluation of this patient, a anterior vertebrectomy, anterior strut grafting and titanium Z plate instrumentation was performed for posttraumatic kyphosis. For this aim MRI evaluation of 10 calf fresh vertebral segments were examined with their anterior vessels and soft tissues were preserved. Five of them were separeted as control group. Titanium Z plate instrumentation was performed in contact with the aorta to there maining 5 calf spines. Averagely 3.8°C of warming of titanium plates with the magnetic thermal effect of MRI was noted. It was demonstrated that an histopathological changes did not occur in soft tissues and vessels both in the samples and the control group. In light of these findings it is suggested that soft tissue damages after MRI did not occur in patients with titanium anterior instrumentation.

Key words: *Titanium plate, histopathology, anterior, thermal effect.*

INTRODUCTION

Magnetic resonance is natural phenomenon that allows some particles, for instance hydrogen nuclei, to absorb and re-emit radiowaves when they are in a magnetic field. In magnetic resonance, for a given type of nucleus, this "special" frequency depends on the strength of the external magnetic field: at 0.5 Tesla hydrogen nuclei respond to 21 MHz, while at 1.5 Tesla they respond to 63 MHz; tripling the magnetic field means tripling the frequency (7). During MRI, the body is submitted to a magnetic field and the protons are stimulated by radiowaves (pulsa sequences). When the stimulation is stopped, the protons re-emit energy in the form of a radiowave; that is the MR signal (10).

MR signals are used to determine the pathologies in bone and soft tissues. MRI is especially more precise in soft tissues. Because of its superior contrast resolution and the capability for multiplanar imaging. MRI has replaced CT as the imaging technique of choice for a variety of spinal disorders (2, 4, 9-10). Implants used for spinal surgery causes serious artefacts in CT or MR images (5-6, 8). For this reason, especially for cases like vertebral fractures that evaluation of spinal canal and stabilizing ligaments is very important MR compatible titanium implants have been developed (6, 11). In the literature there are few reports concerning with the effect of MR signals to the instrumented area. In the literature, one can find papers about implant insufficiancy or tromboembolic diseases, in patients with intracranial clip or artificial heart value after MRI (8). But there is no report about effects of MRI on stability of implant or surrounding soft tissues. This study is prepared for evaluating the effect of MR signals producing aortic aneurisym in a patient who had traumatic kyphosis, operated and implanted anteriorly and then had a aortic aneurisym after the first control MRI. For evaluating this we performed MRI on 10 fresh calf vertebrae and after we evaluated them histopathologically.

MATERIAL and METHOD

In First Department of Orthopaedics and Traumatology of Social Security Hospital, 47 years old female patient was operated for posttraumatic kyphosis. She had anterior corpectomy, strut grafting and was fixed with anterolateral titanium Z-plate. There was no postoperative complication. For evaluating the spinal canal clearance, in the postoperative first month she had MRI. In the hospital referred, she had emergency abdominal exploration and an aortic aneurisym was de-

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tected, it was repaired ant the implant was removed. As the implant was very close to the aorta it was considered that thermal effect of MRI on implant might cause the aneurisym and for evaluating this we developed an animal model.

5 of them being control group, 10 fresh calf cadaver vertebrae were isolated after sacrification, put into ringer lactate and brought into operating room. During dissection, paravertebral soft tissues and aortic segment was especially protected. Z plate was implanted very close to aorta in usual manner. After implantation all the specimens were taken to MR center. We used 0.5 Tesla General Electric MR Max for imaging. All the specimens were exposed to MR signals at same time. With heat gauge, alterations in temperature of Z plate was measured. After this all the specimens were put in formaline taken to pathology institute and observed histopathologically.

RESULTS

There was an average of 3.8° heating (2.2°C-6.4°C) in Z-plates. During the histopathologic examination in the peripheral fascia and in fat tissues there was mild necrosis. In the aortic wall, both in control group and experiment group there was no pathologic changes in cells except mild degrees of necrosis, vacuolisation and swelling.

DISCUSSION

The ability to visualise simultaneously bone structures, bone marrow, ligaments, intervertebral discs, spinal canal and cord, as well as the surrounding soft tissues, in a non-invasive way, makes MR imaging technique extremely useful. A T1-weighted or proton-density sequence allows a rapid initial evaluation of the spine and provides good anatomical detail and soft-tissue contrast. The vertebral bodies have a high signal intensity due to the high fatty content of the marrow and are bordered by a rim of dark, low-signal intensity corresponding to the cortical bone and end-plates. The spinal cord has a higher signal intensity and is easily demonstrated since it is surrounded by the dark signal intensity of the CSF on T1 - weighted images. On T2-weighed images, the marked increase in signal intensity of CSF, contrasing with the lower signal of the spinal cord is known as the myelographic effect (2, 8-9). The multiplanar images of MRI best demonstrated the spine and spinal cord. Canal compromise and medullary compression due to disc herniation, trauma and posttraumatic kyphosis can be detected precisely. Degeneration of corpus, continuity of anterior and posterior longitudinal ligaments can also be detected (7). Tumoral tissues both in bone or in canal, infections and abscess formations can be detected in very early period by MRI (3-4, 6). Noninvasiveness of the technique is another important advantage of MRI. Although some metals are reported to make artefacts in imaging, titanium is shown to be compatible with MR (5-6, 8). But radiowaves heats all kinds of metals. In the previous papers amount of heating is reported to be between 1°C - 10°C. In the literature there are very few about heat damage to surrounding tissues (3, 6, 11). In our study we observed 3.8°C of heating of implant and this didn't cause any adverse effect on surrounding tissues and aorta.

In the literature there are papers reporting good results of Z plate, especially on anterior decompression cases. Z plate is low profile, laterally placed and titanium (1, 12).

In the light of these finding we concluded that our patient's aortic aneurisym could not be related to MR heating effect. May be it's because of a damage to aorta during implantation. If the plate is implanted with a good technique it's because of a damage to aorta during implantation. If the plate is implanted with a good technique it's very effective and in the postoperative period MR imaging is safe for bone and surrounding soft tissues.

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