Journal of Cardiovascular Magnetic Resonance®, 3(3), ix (2001)

EDITORIAL

Editor's Page: Is CMR Safe?

In the present issue of the JCMR there is a review on safety by Ahmed and Shellock. This review was written before one of the most impressive catastrophes associated with clinical magnetic resonance systems. A child's head was crushed by an oxygen tank that was attracted into the bore of a 1.5T system. Similar events have occurred previously resulting in injury, but this is the first crushing injury that resulted in death. The event alarmed everyone: the lay public, patients, hospitals, physicians, scientists, and others. The patient had undergone excision of a brain tumor which was discovered a week before.

As with other modalities, CMR has its risks and precautionary measures need to be taken to insure that such events will not occur. Most of the risks associated with MR are related to human error. Nevertheless, with the increase in field strength of commercial systems to 3.0 Tesla and the gradients to $>$40 mT/m with slew rates of $>$150 T/m/sec, extra precautions should be taken. The slew rate at which physiologic interaction occurs is $\sim$200 T/m/sec. The slew rate is the rate of change of the gradient, while the gradient is the rate of change of the magnetic field. There are strategies to increase the gradient strength without increasing the slew rate to reduce the likelihood of muscle twitching or other physiological effects. However, following gross attractions due to the magnetic field, the most important potential effect of CMR is RF heating. Since the RF is related to the field strength, the trend toward 3T could become problematic. There are a myriad of implants and devices discussed by Ahmed and Shellock that are relatively or absolutely contraindicated. Of course, for the CMR patients, pacemakers, ICDs, retained pacing wires, temporary cardiac pacing wires, metallic stents, and prosthetic valves are the major contraindications. Most deaths associated with these devices have occurred with permanent pacemakers and the precise reason(s) for those (at least 6) deaths is unknown.

Another important issue related to CMR safety is the difficulty in monitoring physiological parameters within the MR system. ECG electrodes have been associated with 3rd degree burns as have electrodes associated with other monitoring devices including pulse-oximeter, plethysonographic systems used for gating, and others. The distortion of the ECG has interfered with the ability to monitor patients for ischemic changes involving the ST segments. Strategies to reduce this distortion are under development.

To conclude, appropriate care and systems are essential to eliminate the risks that can be associated with the magnetic and radiofrequency fields, and the gradients that comprise magnetic resonance studies. Strategies have been used to improve the safety of CMR studies in patients with pacemakers, but this should continue to be considered as research, not approved by FDA. As the indication for CMR increases, we will need to insure that safety is maintained. It is ultimately up to us.

Gerald M. Pohost, M.D., Editor