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Case Report

Spontaneous Discharge of a Firearm in an MR Imaging Environment

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Introduction

An incident recently occurred at an outpatient imaging center in western New York State, in which a firearm spontaneously discharged in a 1.5-T MR imaging environment with active shielding. To our knowledge, this is the first documented case of such an occurrence. The event confirms previously reported theoretic risks of a firearm discharging in an MR imaging environment [1]. In this report, we examine the incident in detail from the official police and ballistic reports.

Case Report

An off-duty police officer went to an outpatient imaging center (not affiliated with our institution) in western New York State to have an MR imaging examination. The facility housed a 1.5-T MR unit (Signa; General Electric Medical Systems, Milwaukee, WI) with active shielding. The officer was carrying a model 1991 A-1 compact .45 caliber semiautomatic pistol (Colt's Manufacturing, Hartford, CT).

The officer notified the technologist that he was carrying the weapon before entering the MR dressing room. The technologist told the officer to take the gun with him. The technologist intended to meet the officer in the MR patient waiting area before the examination and secure the weapon in that room, where he felt it would be safe. However, the

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officer apparently misunderstood and took the gun into the MR suite. The technologist was entering the officer's personal data into the computer and did not see him entering the MR suite.

Once the officer was inside the MR suite, the gun was pulled from his hand as he attempted to place the gun on top of a cabinet 3 ft (0.9 m) away from the magnet bore. The gun was immediately pulled into the bore, where it struck the left side and spontaneously discharged a round into the wall of the room at the rear of the magnet. Fortunately, no one was injured. Although the gun struck the magnet bore, only minimal cosmetic damage occurred to the magnet itself. The MR unit had full functional capability immediately after the gun discharged. The weapon's thumb safety was reportedly engaged when the gun discharged.

An unsuccessful attempt to remove the gun from the magnet resulted in the gun being pulled to the right side of the magnet ([Fig. 1](#)). The decision was then made to power down the magnet to remove the gun.

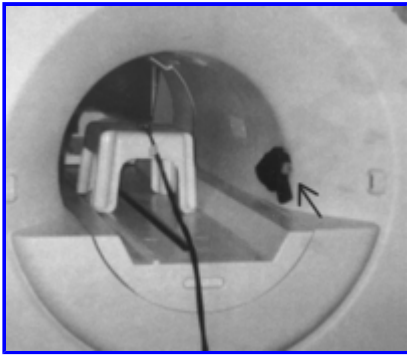


Fig. 1. —Photograph shows gun (*arrow*) stuck on right side of MR imaging magnet bore.

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Examination of the weapon by a ballistics laboratory concluded that the force of the magnetic field was responsible for the firearm's discharge. To understand how the gun discharged requires a brief discussion of the firing mechanics of the Colt 1991 A-1.45 caliber pistol and the weapon's safety mechanisms [2]. When the weapon is normally fired, the trigger is pulled, which releases the sear. The sear, in turn, releases the hammer. The hammer then moves forward to strike the firing pin, which moves forward to strike the primer of the chambered round.

The Colt 1991 A-1 pistol has three safety mechanisms (Fig. [2A,2B,2C,2D](#)), including a thumb safety, grip safety, and firing pin block. The thumb safety locks the sear in place and prevents the hammer from moving forward when the trigger is pulled. The thumb safety also locks the slide in place. The thumb safety is the weapon's only active safety mechanism; it must be turned on in order to work. The grip safety is located at the back of the gun handle and prevents the trigger from being depressed. The grip safety is a passive mechanism; it is always on unless deactivated. To deactivate it, the grip safety must be depressed at the same time the trigger is depressed; otherwise, the trigger cannot be pulled. The firing pin block is a small metal block, approximately the size of a pencil eraser, that sits in the firing pin channel and prevents the firing pin from moving forward. The firing pin block is held in place by a small spring. When the trigger is pulled, a series of levers cam the firing pin block up into its own well within the slide to allow the firing pin to move freely within its channel.



Fig. 2A. —Photographs of 1991 A-1.45 caliber semiautomatic pistol (Colt's Manufacturing, Hartford, CT). Actual gun involved in incident is shown.

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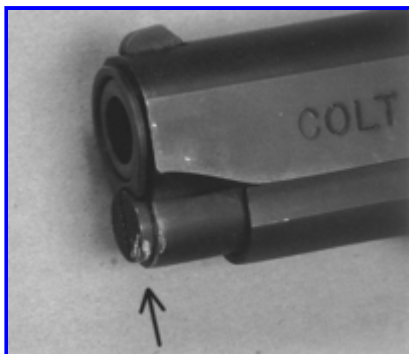


Fig. 2B. —Photographs of 1991 A-1.45 caliber semiautomatic pistol (Colt's Manufacturing, Hartford, CT). Muzzle of gun shows small amount of white paint (*arrow*) where gun impacted magnet.

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Fig. 2C. —Photographs of 1991 A-1.45 caliber semiautomatic pistol (Colt's Manufacturing, Hartford, CT). Hammer, thumb safety, and grip safety of gun are shown. Gun is in cocked and locked position with hammer cocked and thumb safety turned on to prevent hammer from striking firing pin. This is condition in which gun was recovered from magnet.

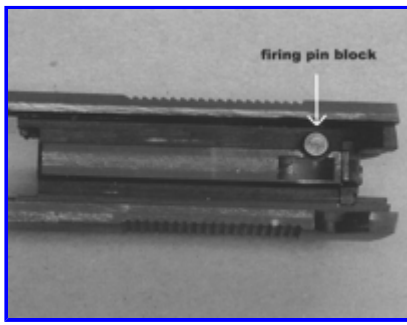
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Fig. 2D. —Photographs of 1991 A-1.45 caliber semiautomatic pistol (Colt's Manufacturing, Hartford, CT). Disassembled gun with view of slide interior from below shows firing pin block.



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At the time the weapon discharged, it was reportedly in a cocked and locked position; that is, the hammer was cocked and the thumb safety was engaged to prevent the hammer from striking the firing pin. A live round was in the chamber. (Many people who choose this weapon for personal protection will carry it in this manner because it allows them to quickly fire the weapon if needed.)

When the firearm was removed from the magnet, the gun was still in a cocked and locked position. An empty cartridge was found in the chamber. The presence of an empty cartridge in the chamber is highly unusual. If the thumb safety were not engaged and the weapon fired normally by depressing the trigger, the normal backward recoil of the slide should have automatically ejected the empty cartridge, and a new live round should have automatically been chambered. As discussed earlier, the thumb safety performs two functions: it prevents the sear from releasing the hammer, thereby preventing the hammer from striking the firing pin; it also locks the slide in place, preventing retrograde motion of the slide and automatic ejection of the empty cartridge. Thus, the presence of an empty cartridge in the chamber confirms that the thumb safety was engaged at the time the gun was fired. Given that the thumb safety was engaged when the gun discharged, it is also likely that the normal trigger and hammer mechanism of firing the gun was bypassed because the thumb safety would have also prevented release of the hammer.

The gun likely discharged as a result of the effect of the magnetic field on the firing pin block. The firing pin block was probably drawn into its uppermost position by force of the magnetic field. The firing pin block has to overcome only light pressure from a relatively small spring to release the firing pin. The pistol was likely drawn into the magnetic field so that the muzzle struck the magnet's bore first. With the firing pin allowed to move freely in its channel, the force of the impact on the muzzle end was sufficient to cause the firing pin to overcome its spring pressure and move forward to strike the primer of the chambered round.

This account explains how the weapon discharged when the thumb safety was engaged.

The presence of an empty cartridge in the chamber explains why the gun did not discharge a second time when it was moved from the left to the right side of the bore. Even if the identical forces were repeated, an empty cartridge, not a live round, was in the chamber at this time.

Discussion

In this incident, the gun discharged despite the thumb safety being engaged. This has important

implications in that it shows that the weapon poses a risk for discharging in an MR imaging environment even with the thumb safety engaged.

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One can look at the sequence of events preceding the discharge of the weapon and see several points at which the incident could have been prevented. When the officer came in with the gun, it should have been immediately secured in a safe location, even before the officer changed for the examination. The technologist, knowing the officer had a firearm, should have instructed him that under no circumstances could he bring the weapon into the MR suite. Also, the technologist should have been monitoring the officer more closely to make sure he did not enter the MR suite with the weapon. Signs should have been posted at that site, if they were not already there, warning the public of the dangers of approaching the magnetic field of the MR imager with implants, metallic devices, or objects such as firearms.

In light of this incident, all radiologists should reexamine our own site's screening methods to ensure that steps are implemented to prevent such a situation from ever recurring.

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