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An Unexpected Cause of Magnetic Resonance Image Distortion: The Endotracheal Tube Pilot Balloon

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ANESTHESIA services in the magnetic resonance imaging (MRI) suite are increasing and require that the anesthetic equipment used is adequate to ensure patient safety, is MRI compatible, and has a negligible effect on image quality. We report a case in which the MRI scan quality was noticeably degraded by an unsuspected but commonly used piece of anesthesia equipment, the pilot balloon valve of a conventional endotracheal tube.

Case Report

A 17-yr-old trauma patient with a known L₄ burst fracture required general anesthesia for a detailed MR examination of the spine and paraspinal region. After successful induction of general anesthesia, the patient's trachea was intubated with a 7.0 cuffed endotracheal tube (Lo-Pro; Mallinkrodt Medical, St. Louis, MO). The initial T₂-weighted, gradient recalled MR examination revealed gross image degradation in the sagittal and transverse sections of the cervical spine region. The image artifact was consistent with ferromagnetic interference. A search for a source of ferromagnetic interference was initially unsuccessful. A radiology technician reported that similar interference had been observed in the past and was related to the position of the pilot balloon. Repositioning the pilot balloon 5 cm away from the surface of the neck area eliminated the distortion in a repeated MR scan. Subsequent inspection of the pilot balloon revealed a ferromagnetic spring that closes the pilot balloon valve.

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Discussion

The strength of the magnetic field and the nature of the signal needed to generate the image requires that the anesthesiologist use nonferromagnetic materials in the MRI suite. It has long been known that ferromagnetic materials can interfere with the magnetic field generated by the MRI scanner.^{1,2}

This case illustrates how even a very small ferromagnetic object can severely distort a magnetic resonance image in an adult patient. Brenn and Saldutti³ reported a similar episode of ferromagnetic interference during an MRI scan in a 6-month-old infant. The larger body size of the adult and the greater distance from the skin and pilot balloon to the internal structures to be examined does not appear to offer any significant protection of MRI quality. Pilot balloon springs of oral RAE tubes and laryngeal mask airways have also been implicated in MRI degradation.^{4,5} The spring within the pilot balloon valve apparatus (Bespak PVC Medical Check Valve, Tenax Corporation, Apex, NC) is made of stainless steel and causes the image distortion. Image degradation only occurs when the pilot balloon valve containing this spring lies directly on the area of the head or neck to be scanned (fig. 1). According to the manufacturer (Tenax Corporation), this spring is present in all biomedical pilot balloon valves. Although plastic versions have been used in the past, the spring is best made of stainless steel because of its small size and the need for highly reliable operation. The risk for direct patient injury *via* induced heat production or dislocation of the valve spring is insignificant. The type of image distortion described by this report is easily avoided by placing the pilot balloon as far from the area to be examined as possible. We have found it convenient to secure the pilot balloon near the y-connector of the anesthesia circuit, thereby separat-

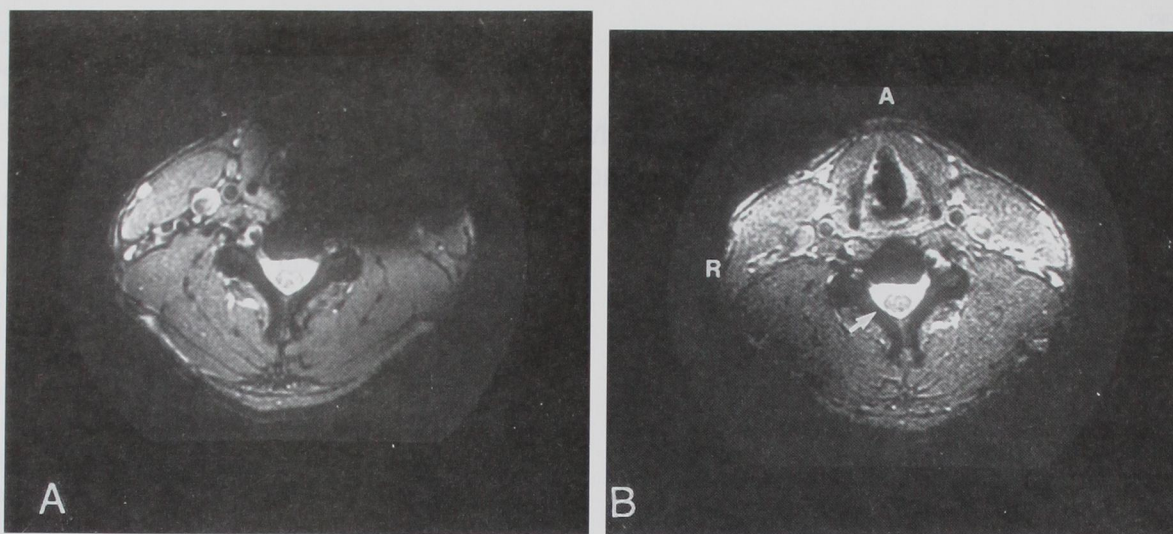


Fig. 1. (A) Axial magnetic resonance image (MRI) of the cervical region showing the large artifact attributable to ferromagnetic interference. (B) Result of a repeated MRI using the same image plane and MR technique as in A. The pilot balloon has been attached to the y-connector of the ventilator tubing, eliminating the ferromagnetic image distortion. A = anterior; R = patient's right; arrow indicates the spinal canal.

ing the pilot balloon from the skin surface by at least 3 cm and preventing image distortion.

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