DETECTION OF ORTHOPAEDIC IMPLANTS BY AIRPORT METAL DETECTORS

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We have assessed the effect of a variety of implants commonly used in fracture fixation and joint replacement on the activation of metal detectors at airport security gates. A volunteer with metal implants strapped on and patients with implants in situ walked through the device. Implants used in fixation do not activate it, except for Richards cannulated screws. An Austin-Moore prosthesis does set off the detector, but a single joint replacement does not. Three or four joint replacements activate the alarm and patients with these implants should be warned of this possibility.

RESULTS

When the implants were strapped to a volunteer, none of those used for fracture fixation activated the alarm at setting 5, nor did a single or two joint replacements. An Austin-Moore prosthesis, and a total of three or four joint replacement prostheses, did set it off. When 16 patients with metal implants were tested, none of the devices listed, either individually or in combination, activated the alarm at a setting of 5. Both patients with three Richards cannulated screws set off the machine at a setting of 7. All the other patients, including one with a dynamic compression screw, one 4.5 mm dynamic compression plate and an unreamed femoral nail, failed to activate the alarm at either setting.

Prostheses used in hemiarthroplasty or joint replacement were tested individually. Only the Austin-Moore prosthesis activated the alarm consistently at both settings. One Thompson hemiarthroplasty did not activate the alarm but two Thompson prostheses did so at both settings.

With total joint replacements, one arthroplasty did not activate the alarm at either setting. Four patients with two hip replacements failed to activate the detector at a setting of 5, but sometimes did so at 7. Patients with a single total...
knee replacement did not sound the alarm at a setting of 5, but one of the patients tested activated the alarm at 7. Two patients with two total knee replacements did not activate the detector at 5 but did at 7. One patient with three and three patients with four total joint replacements activated the detector at settings of both 5 and 7 (Table II).

DISCUSSION

Metal detectors create an electromagnetic field. When a magnetically active metallic object is moved across this field an induction current is generated which is registered by the detector. This process is not affected by the presence or absence of a cover of body tissues, and therefore, theoretically, the result will be the same whether the implant is inside a patient or strapped to a volunteer. We noted some differences in our results. When two total hip replacements (Charnley and Müller) were strapped to a volunteer the alarm was not activated at either setting, but patients with two hip prostheses activated the alarm at a setting of 7. Similar differences were seen with the combination of two total knee prostheses.

Van Rhine and Verart assessed patients who had Harrington rods in operations for scoliosis, and found that they did not activate metal detectors. Pearson and Matthews found that none of the implants which they tested activated the detector, except for an occasional positive result for an Austin-Moore prosthesis. The limitations imposed by federal law prevented them studying the effect of changes in the sensitivity of the detector.

Many factors affect the rate of detection of metallic objects, including some influence from electric cables or other sources of electromagnetic radiation in close proximity. The important features are the size of the object, the content of magnetic material, usually iron, and the sensitivity of the detector, which can be varied. Implants with a higher content of iron are more likely to activate the alarm, and its sensitivity setting determines the minimum amount of iron or other magnetic material that can be detected. Another factor is that the composition of metals used in orthopaedic implants has changed significantly in recent years. Alloys have changed, and newer combinations of metals with improved physical properties and biocompatibility continue to be produced.

Our current findings are that patients with implants such as plates, screws and nails which have been used for internal fixation will not usually activate a detector, except for Richards cannulated screws which will set it off at the higher setting of 7. Patients with a single joint replacement are unlikely to activate a metal detector at its normal setting, but those with two total replacements may do so at a higher setting. Patients with one Austin-Moore prosthesis or three or four standard hip and knee replacements will usually activate an alarm and should be warned of this, and may be provided with a suitable certificate.

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REFERENCES