

The use of a metal detector to locate ingested metallic foreign bodies in children.

B Tidey, G J Price, C A Perez-Avilla, I J Kenney

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Abstract

Objective—A pilot study to assess whether modern metal detectors can reduce unnecessary radiation in searching for ingested metallic foreign bodies.

Methods—Over a one year period, 20 children presenting to an accident and emergency department with suspected metallic foreign body ingestion were studied. Using an Adams Electronics AD15 metal detector, the radiographer recorded the location of metallic foreign bodies on a pictorial representation of neck, chest, and abdomen. The child then had plain radiographs of abdomen, chest, and neck in sequential order until the foreign body was located.

Results—In seven cases neither metal detector nor radiography revealed a foreign body (true negatives). In the remaining 13 cases where metal detection was positive, subsequent radiography or faecal search was also positive (true positives). The 13 foreign bodies were coins (8), gold ring (1), ball bearing (1), screw (1), staple (1), and washer (1). All were in the stomach or proximal small bowel on radiography except for one coin in the right iliac fossa.

Conclusions—The detector can demonstrate ingested metallic foreign bodies reliably in children, thereby reducing unnecessary irradiation.

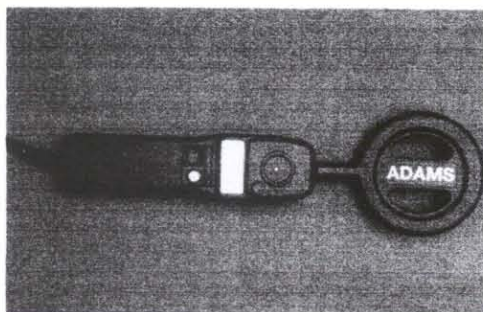
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Key terms: children; foreign body; metal detector

Our local protocol for ingested foreign bodies excluded children over the age of five years who had swallowed "non-hazardous" foreign bodies from further investigation. Younger children or those suspected of ingesting hazardous foreign bodies (batteries or sharp objects) required radiographic confirmation and localisation. A previous internal audit¹ has shown that below the age of five years a significant minority (30%) of children with a history of metallic foreign body ingestion have negative plain films. We present the results of a study to assess whether a modern metal detector can reduce this unnecessary radiation burden.

Methods

Informed parental consent was obtained. All studies were performed by a radiographer after prior training and familiarisation with the equipment. The original x ray based protocol



The AD 15 metal detector.

remained in force throughout, and as the addition of the metal detector study carried no risk or operational change, ethics approval was not considered necessary. Over a one year period, 20 children presenting to the accident and emergency (A&E) department at the Royal Sussex County Hospital in Brighton with suspected metallic foreign body ingestion were studied. This represents less than the total number of children with foreign body ingestion in our area, as many are taken directly to a nearby children's hospital. The detector used was an Adams Electronics AD 15 (figure) (Adams Electronics, East Sussex). It has a search coil emitting a low energy electromagnetic field which, when disturbed by metal, gives audio and visual alarms. Although the field is low energy, the proximity of a pacemaker is considered a contraindication. All metals can be detected, whether ferrous, non-ferrous, pure, or alloy. The scan is simple to perform, although some basic training is required.

The scan starts at the neck, passing inferiorly over the chest wall to include the region of the oesophagus and both major bronchi, and keeping as close as possible to the skin surface. The entire abdomen was examined and the rectum included posteriorly if the rest of the examination was negative. The radiographer recorded the location of the foreign body on a pictorial representation of neck, chest, and abdomen for analysis. The child then went on to have plain radiographs, according to the existing protocol, of abdomen, chest, and neck in sequential order until the foreign body was located.

Results

Twenty children were included in the study (12 boys and eight girls). They ranged in age from one to nine years, with a mean of 3.6 years. The ingested foreign bodies according to the clinical history, were 13 coins, one battery, one gold ring, two screws, one ball bearing, one washer, and one staple.

Royal Sussex County
Hospital, Brighton,
United Kingdom
Department of
Imaging
B Tidey
G J Price

Accident and
Emergency
Department
C A Perez-Avilla

Department of
Imaging, Royal
Alexandra Children's
Hospital, Brighton,
United Kingdom
I J Kenney

Correspondence to:
Mr B Tidey, Superintendent
Radiographer, Department
of Imaging, Royal Sussex
County Hospital, Eastern
Road, Brighton, Sussex BN2
5BE.

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In seven cases neither the metal detector nor radiography revealed a foreign body (true negatives). In the remaining 13 cases where metal detection was positive subsequent radiography or faecal searches were also positive (true positives). These 13 foreign bodies were eight coins, one gold ring, one ball bearing, one screw, one staple, and one washer. All were in the stomach or proximal small bowel on radiography except for one coin in the right iliac fossa. No oesophageal foreign bodies were found in the study. There were no false negatives or false positives.

Discussion

Children are unreliable historians with respect to the ingestion of foreign bodies, and this results in a significant amount of unnecessary irradiation. Previous attempts to locate ingested metallic foreign bodies using commercially available hand held metal detectors have proved unreliable.^{2,3} With improvements in technology, our results – despite the small numbers suggest that there are now metal detectors available which can reliably demonstrate ingested metallic foreign bodies in children. The AD15 uses a unique system of detection, details of which are commercially sensitive and are not generally available. The sensitivity of the detector is dependent on the size, composition, and proximity of the metallic foreign body to the detector search coil. Metal detectors will also identify aluminium foreign bodies, not demonstrable by any other techniques.⁴⁻⁶ When combined with a clinical history of the nature of the ingested foreign

body, the need for radiographs can be reduced as follows:

- (1) Where metal detection is negative no radiography is required.
- (2) Where metal detection is positive, the foreign body non-hazardous, and detected below the epigastrium, no radiography is required. Follow up metal detection is repeated in a week to ensure clearance.
- (3) Where metal detection is positive, the foreign body non-hazardous, but detected in or above the epigastrium, radiography is required to exclude oesophageal retention. If the foreign body is not subsequently removed then metal detection can be repeated to ensure clearance.
- (4) Where metal detection is positive and the foreign body is hazardous, radiography is required to allow accurate localisation and consideration of management options.

CONCLUSION

We believe the Adams Electronics AD15 metal detector is simple and accurate to use and can reduce the need for x rays in this common paediatric problem.

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