The Royal College of Emergency Medicine

Best Practice Guideline

Ingestion of Super Strong Magnets in Children

May 2021
Summary of recommendations

1. Consider magnet ingestion in unwell children with gastrointestinal symptoms.

2. Do not use metal detectors for the assessment of children with suspected rare earth magnet ingestion.

3. All symptomatic rare earth magnet ingestion should be discussed with a specialist regional paediatric surgical centre in the first instance.

4. The progression of the magnet/magnets through the gastrointestinal tract is crucial to determining whether surgical intervention is required.

5. Repeat abdominal X-rays should be performed after 6-12 hours in those children who are asymptomatic and meet the discharge criteria.

6. Interpretation of the abdominal x-ray and the finding of progression of the rare earth magnet through the gastrointestinal tract should be formally confirmed by a radiologist.

7. Patient Advice leaflets with appropriate ‘safety netting’ information should be given to any parent/patient discharged.
Scope
This guidance relates specifically to the ingestion of rare earth magnets in children.

Reason for development
Raise awareness of the risks associated with ingestion of rare earth magnets and provide guidance for clinical management of paediatric patients who are suspected to have ingested super-strong magnets.

Introduction
Neodymium magnets (also known as NdFeB, NIB, Neo magnet or Super Strong Rare-Earth Magnets) have become easy to purchase and are promoted as ‘adult desk toys’ or ‘stress relievers’ (Appendix 1). Neodymium is a rare earth element that is used alongside iron and boron in the production of newly engineered powerful magnets (NM) for the manufacturing industry and many household items. Rare earth magnets are between five and ten times stronger than ceramic magnets and are sometimes called ‘super strong’ or powerful magnets. They are often brightly coloured and can be of a variety of shapes such as balls, cylinders, discs, ellipses and bars, usually of less than 6 mm in diameter [1]. These inexpensive and readily available magnets can be accidentally swallowed by children with ease. It is concerning that these magnets are still being easily purchased in the UK. Legislation in the US that resulted in selling bans and products recalls that were followed by a marked reduction in the number of accidental ingestions [1]. Anecdotal evidence from across the UK has identified that the incidence of magnet ingestion is increasing, especially in older children who may have been attempting to mimic tongue and cheek piercings, as well as permanent dental work leading to accidental ingestion.

The ingestion of a single rare earth magnet is unlikely to cause significant harm, however, if multiple magnets are ingested, or if a magnet is swallowed along with a metal object significant injury can occur. Ingestion of a magnet with a button battery is a time critical emergency. Magnets can attract each other across layers of bowel to cause ischemia and pressure necrosis of the gut and serious complications. The types of injuries have included ulceration, necrosis, perforation, rupture, stricture, fistula, haemorrhage, mediastinitis, gastric outlet or bowel obstruction, volvulus, sepsis and death. [2]

A symptomatic child or young person who has ingested a rare earth magnet requires urgent discussion with a tertiary paediatric surgical team. The presence of symptoms with a history of rare earth magnet ingestion is highly likely to require surgical intervention. Perforation occurred in 50 to 75% of the symptomatic
patients at presentation [1,3]. Fistula formation may occur within 2 to 5 days. Surgical intervention is indicated when endoscopic removal is not indicated or is not possible because of the location, number of magnets or several bowel loops are attached to each other.

Weaker ceramic/ferric (‘ordinary’) magnets can also cause serious damage, particularly when more than one has been ingested or has been co-ingested with another metallic object. If there is any doubt as to the type of magnet ingested the safest course of action is to assume it is of the rare earth variety.

**Presentation**

Consider the possibility of rare earth magnet ingestion or aspiration in patients with stridor, wheezing or other noisy breathing; drooling; difficulty swallowing; coughing, choking or gagging when eating or drinking; vomiting; chest pain or discomfort; abdominal pain; decreased appetite or refusal to eat. Abdominal symptoms may not manifest for weeks after ingestion of magnets however intestinal injury can occur early, within 8-24 hours following ingestion, despite the child often remaining well. [1]

<table>
<thead>
<tr>
<th>Box 1. Risk Factors for Complications following ingestion rare earth magnets</th>
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<tbody>
<tr>
<td>• Those who have co ingested a magnet with a button battery [4]</td>
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<tr>
<td>• Those who have ingested multiple magnets or a magnet and another metal object [5]</td>
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<tr>
<td>• Children and young people with developmental, behavioural or psychiatric problems</td>
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<tr>
<td>• Delayed presentation (&gt;12 hours after presentation) [6]</td>
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**Management**

Unlike most other 'foreign body' ingestions, passage of rare earth magnets into the stomach must not be used as an indication that a child is free from any potentially catastrophic underlying injury. The progression of the magnet/magnets through the GI tract is crucial to determining whether surgical intervention is required. See Appendix 2 for management algorithm.

Do not use metal detectors for the assessment of children with suspected rare earth magnet ingestion.
Chest X-ray and abdominal X-ray (with the patient lying down, ideally AP) should be requested to assess both the position of any magnets and the number of magnets. In the case of a single magnet being identified on an abdominal X-ray, a lateral abdominal X-ray should also be requested to confirm that only one magnet has been ingested.

Pitfalls in radiological interpretation include:

i. A neodymium magnet appears like a ball-bearing on an X-ray, and clinicians should be careful to not misdiagnose it as a metal ball [7]

ii. Misdiagnosis of multiple magnets as solitary magnet ingestion can lead to a delay in diagnosis and subsequent complications (box 2)

Box 2. Radiological pitfalls in the interpretation of rare earth magnet ingestion

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The following patients should be considered suitable for discharge after rare earth magnet ingestion:

- single magnet ingestion,
- accidental ingestion,
- no co-morbidities,
- tolerating oral intake,
- presents within 24hr of ingestion,
- care-giver able to provide close observation (there is no need to examine the child’s faeces).

All patients who are being discharged with rare earth magnet ingestion require follow-up imaging after 6-12 hours, repeated earlier imaging is not indicated. If the child becomes symptomatic before the repeat radiograph urgent surgical review will be required. Follow up abdominal X-ray should be requested (only repeat CXR if magnets seen in the chest on the first image). It is essential that the abdominal radiographs are always performed in the same position (lying down, ideally AP). Interpretation of the abdominal x-ray and the finding of progression of the rare earth magnet through the gastrointestinal tract should be formally confirmed by a radiologist.

Follow-up AXRs should continue to be performed until it can be demonstrated (and confirmed by a radiologist) that the magnet has passed through the stomach and serial X-rays (at least 6-12hrs apart) show that it is progressing through the small bowel or beyond. Failure of the magnet to progress through the gastrointestinal tract, (defined as: the magnet having not moved from the last demonstrated position on AXR irrespective of location in GI tract after a period of 6-12hrs and confirmed by a radiologist) is an indication for discussion with a specialist regional paediatric surgical centre.

If a single magnet is ingested, it can be expected to be passed spontaneously, if the magnet is not too large [1]. If a rare earth magnet has been ingested, remove any other external magnetic objects nearby and avoid clothes with metallic buttons or belts with buckle. Parents / patient should be provided with a patient advice leaflet (Appendix 3).

Patients who do not meet discharge criteria eg. symptomatic patients, signs of deterioration, ingestion of two or more rare earth magnets should be discussed with a specialist regional paediatric surgical centre in the first instance. Admission under the care of a local surgical team maybe appropriate, after discussion with the regional paediatric centre. This admission would enable close observation as well as repeat imaging and in the event of any deterioration, rapid transfer to the regional paediatric centre.
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Revision June 2021 reference to ‘prone’ X-rays removed and replaced with ‘AP’

Review
Usually within three years or sooner if important information becomes available.

Conflicts of Interest
None

Disclaimers
The College recognises that patients, their situations, Emergency Departments and staff all vary. This guideline cannot cover all possible scenarios. The ultimate responsibility for the interpretation and application of this guideline, the use of current information and a patient’s overall care and wellbeing resides with the treating clinician.

Research Recommendations
None

Audit standards
None

Key words for search
Magnets, Neo magnet, Super Strong, Rare-Earth Magnets, foreign body, paediatric
References


Appendix 1 - Examples of Super Strong or Powerful or Rare Earth Magnets
Appendix 2 - Management Algorithm

Witnessed or suspected rare earth magnet ingestion OR
Unexplained GI symptoms with rare earth magnets in the child’s environment
(Follow TOXBASE advice whilst following the flowchart below)

Request Urgent Erect CXR and AXR (with the patient lying down, ideally AP).
Request a lateral AXR only if a single magnet is seen

- Symptoms or Signs of Intestinal Obstruction
- Multiple Magnets
- Evidence of Intestinal Obstruction

Discharge Criteria Met?
- Single magnet

Discuss with local surgical team (+/- paediatric) for admission and observation and repeat X-ray

Symptoms or Signs at any time

Discharge with safety net advice and patient advice leaflet

Failure of magnet to progress but remains asymptomatic

Progression of single magnet (confirmed by radiologist) AND remains asymptomatic

Follow-up AXRs at least 6-12hrs apart until it can be demonstrated that the magnet has passed through the stomach and it is progressing through the small bowel or beyond. Ensure same position for the AXR on each occasion

Patient Advice leaflet
Return for repeat X-ray

Discussion with Specialist Paediatric Surgical Centre to make plan for further imaging, observation +/- removal

If a rare earth magnet ingested with a button battery this is a TIME CRITICAL EMERGENCY (refer to local button battery guidance)

Discussion with Specialist Paediatric Surgical Centre to plan further management +/- transfer

Met?
- Single magnet ingestion
- Accidental ingestion
- No co-morbidities
- Tolerating oral intake
- Presents within 24hr of ingestion
- Caregiver can provide close observation
Appendix 3 - Example of a Patient Advice leaflet

Recently, a different type of magnet (also known as Neo magnet, Bucky balls, Magnet balls or Super Strong Rare-Earth Magnets) has gone on sale. They are most often sold as ‘adult desk toys, stress relievers or brain development toys’ and it not legal to sell them to children less than 14 years of age.

They are between seven and fourteen times stronger than traditional magnets and are sometimes called super strong or powerful magnets. They can be a variety of shapes, most often balls or discs. These are some examples of what they look like.

Today, your child has been discharged after swallowing of a magnet. Even though the magnet has not passed through them yet, it is OK to take your child home.

After going home, your child will need a follow up X-ray 6-12 hours later and you should have been given a time to re attend the Emergency Department. This follow up X-ray is extremely important so doctors can make sure the magnet is moving normally through your child’s bowels.

Until your child has had their repeat X-ray, remove any other external magnetic objects nearby and avoid clothes with metallic buttons or belts with buckle

There is no need to examine your child's faeces to find the swallowed object.

If a single magnet is ingested, it can be expected to be passed spontaneously if the magnet is not too large.

Very rarely, the object can become stuck in the stomach or intestines. Take your child the Emergency Department IMMEDIATELY if they have

- Concerns of further magnet or foreign body ingestion
- Vomiting
- Abdominal (tummy) pain
- Blood in their vomit or poo
- A fever
- You have concerns about a change in your child’s eating patterns e.g. refusing food or fluids
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