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]

Box 1. Risk Factors for Complications following ingestion rare earth magnets

- Those who have co ingested a magnet with a button battery [4]
- Those who have ingested multiple magnets or a magnet and another metal object [5]
- Children and young people with developmental, behavioural or psychiatric problems
- Delayed presentation (>12 hours after presentation) [6]

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

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.

Author

Working consensus group for the ingestion of magnets:
Chair; Sarah Stibbards
Members; Simon Kenney, Suzy Emsden, Caren Landes, James Price, Sarah Almond, Teik Choon See, Shruti Agrawal, Ashish Desai, Harry Bliss, Rachel Harwood, Emily Decker

Acknowledgements

Best Practise Committee, QEC

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

1. Hussain SZ, Bousvaros A, Gilger M, Mamula P, Gupta S, Kramer R, Noel RA. Management of Ingested Magnets in Children. JPGN 2012; Volume 55 (3): 239–242

2. Alfonso M and Baum C (2016) Magnetic Foreign Body Ingestions. Pediatr Emegr Care; 32: 698-704 [8]

3. Tavarez M, et al (2013) Prevalence, Clinical Features and Management of Pediatric magnetic Foreign Body Ingestions. J Emerg Med; 44(1): 261-268 [9]

4. Shastri N, Leys C, Fowler M, Conners GP. Pediatric button battery and small magnet co-ingestion: two cases with different outcomes. Pediatr Emerg Care. 2011; 27(7): 642-4.

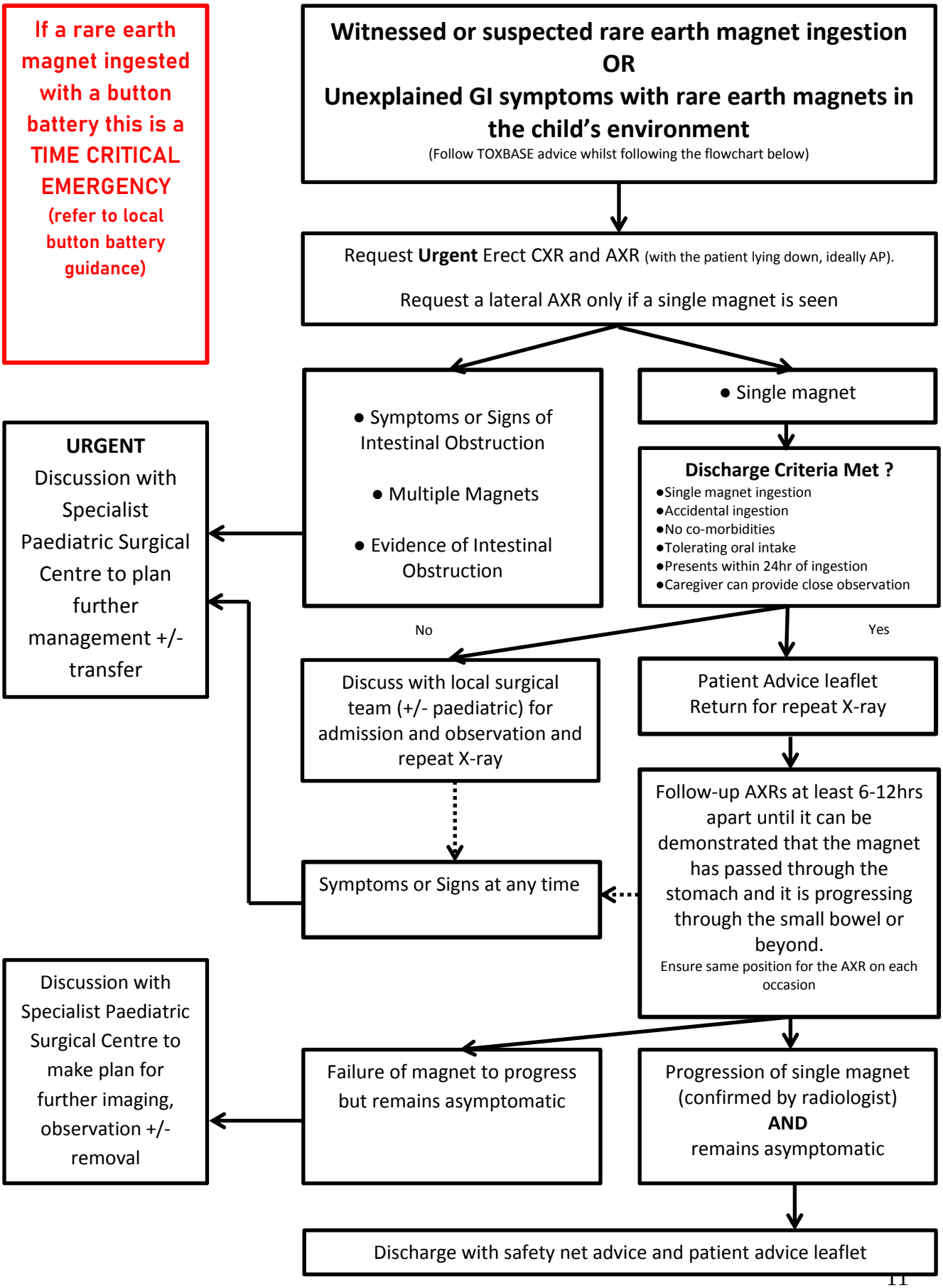
5. Han Y, Youn JK, Oh C, Lee S, Seo JM, Kim HY. Ingestion of multiple magnets in children. J Pediatr Surg. 2020; 55(10): 2201-2205.

6. Bauman B, McEachron K, Goldman D, Louiselle A, Zheng E, Mills D, Louie J, Segura B. Emergency Management of the Ingested Magnet: An Algorithmic Approach. Pediatr Emerg Care. 2019; 35(8) :e141-e144.

7. Hyuk Lee J, Foreign Body Ingestion in Children. Clin Endosc 2018; 51: 129-136

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

Appendix 2- Management Algorithm



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

The Royal College of Emergency Medicine

The Royal College of Emergency Medicine
7-9 Breams Buildings
London
EC4A 1DT
Tel: +44 (0)20 7400 1999
Fax: +44 (0)20 7067 1267
www.rcem.ac.uk

Incorporated by Royal Charter, 2008
Registered Charity number 1122689

Excellence in Emergency Care