Int J Clin Exp Med 2017;10(11):15713-15718
www.ijcem.com /ISSN:1940-5901/IJCEM0061777

Case Report

Barium-induced intestinal obstruction: a case report and literature review

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Received July 19, 2017; Accepted November 1, 2017; Epub November 15, 2017; Published November 30, 2017

Abstract: *Objective:* The clinical use of barium can result in barium-induced intestinal obstructions. The aim of this report is to address the factors related to barium-induced intestinal obstructions and suitability of patients for treatment. *Methods:* One case of barium obstruction admitted to the Emergency Department of our hospital is reported. A search of PubMed and MEDLINE from 1980-2016 identified 19 similar cases concerning barium-induced intestinal obstruction, which are systematically reviewed. *Results:* Four patients recovered after conservative treatment, four patients were treated by colonoscopic litholysis, and another 11 patients received surgery after ineffective conservative treatment or acute abdominal complications. *Conclusions:* It is important to weigh the advantages and disadvantages of a barium examination for groups at high-risk for intestinal obstruction. If conservative treatment is ineffective, it is necessary to carry out a surgical procedure.

Keywords: Barium sulfate, colonoscopy, intestinal obstruction, barolith, case report

Introduction

Barium sulfate is a contrast agent that is commonly used in clinical diagnosis and treatment of digestive tract diseases, and has an important role in clinical practice due to its unique convenience and economic efficacy. Reports of intestinal obstruction caused by barium retention in China and worldwide are rare. To discuss the high-risk groups and treatment of barium-induced intestinal obstruction, the current study includes one case of intestinal obstruction after a barium meal treated in our hospital. Also the relevant literature is reviewed to guide clinicians to identify the suitable population for barium examinations and apply the appropriate treatment when obstruction occurs.

Case report

One female patient, 39 years of age, visited the Emergency Department of our hospital for evaluation of "nausea and vomiting for 20 days". The patient reported that these symptoms persisted during this time without an obvious cause other than that vomiting was associated with eating. She did not have abdominal pain, fever, or diarrhea. The patient had no history of hypertension, coronary heart disease, diabetes or other chronic illness. She had no history of surgical trauma, cigarette smoking, alcohol consumption, or infectious diseases. Her mother had depression.

The physical examination results were as follows: blood pressure, 130/80 mmHg; heart rate, 76 beats/min; conscious; no conjunctival pallor; no yellow sclera; no obvious abnormalities in the heart and lungs; flat abdomen without gastrointestinal peristalsis; soft abdomen with tenderness of the lower abdomen; no rebound pain or muscle tension; liver and spleen were not palpable; shifting dullness; and weak bowel sounds. Laboratory testing revealed the following: routine urinalysis [white blood cell count = 9.4/high power field (HPF), red blood cell count = 8.4/HPF, K = 3.22 mmol/L, total bilirubin (TBIL) = 21.6 μmol/L, unconjugated bilirubin (UBIL) = 14.1 μmol/L]; blood gas analysis [pH = 7.48, PCO_2 = 39 mmHg, PO_2 = 88 mmHg, actual bicarbonate = 29 mmol/L, and extracellular residual alkali = 5.5 mmol/L];

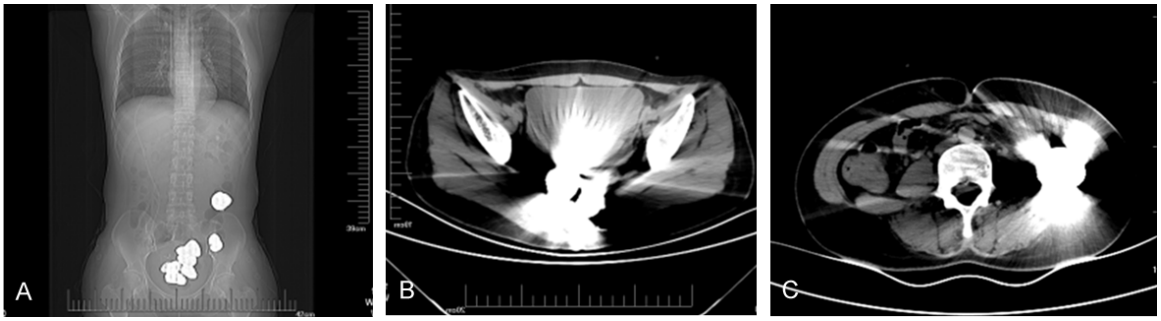

Figure 1. Abdominal CT when the patient was admitted to the hospital (A-C) (see **Table 1**).

Figure 2. Abdominal plain films after treatment. Films show barium locations for 3 consecutive days (A-C) (see **Table 1**).

coagulation profile [prothrombin time (PT) = 13.9 s, plasma thromboplastin antecedent (PTA) = 69%, activated partial thromboplastin time (APTT) = 40 s, D-dimer = 446 μg/L]; random blood glucose, 6.69 mmol/L; Lupus anticoagulant (LA), 4.8 mmol/L; white blood cell count, 6.71 × 10^9/L; neutrophil percentage, 70%; hemoglobin, 138 g/L; platelet count, 206 × 10^9/L; procalcitonin (PCT), < 0.02 (normal, < 0.05); and C-reactive protein (CRP), 6.03 (normal, 0-8).

A whole abdominal CT scan (**Figure 1A-C**) revealed retained intestinal barium. The medical history was significant for a barium meal 20 days previous in a local hospital for an X-ray examination. After the diagnosis of intestinal obstruction was established, the patient was asked to fast. Pantoprazole was administered for acid suppression to protect the gastric mucosa, and parenteral nutrition with potassium was provided to correct the electrolyte disorder. A soapy water enema, lactulose, and mosapride were then administered to promote gastrointestinal peristalsis. An orthostatic abdominal plain film (**Figure 2A**) revealed that the front edge of the barolith had progressed from the descending colon to the sigmoid colon. On the third day, the patient had a sensation of abdominal distension, but defecation was difficult. Glycerin was administrated to promote defecation. Three hard baroliths, approximately 2 cm × 3 cm in diameter, were removed manually.

An abdominal X-ray was obtained immediately after defecation (**Figure 2B**), which showed that the left colon was filled with barium. Considering the large quantity of caked, residual barium in the colon, the treatment was continued for another 3 days, during which the patient defecated without visible baroliths. A repeat orthostatic abdominal plain film (**Figure 2C**) showed that all of the residual barium had been discharged. At this time abdominal distension had been relieved and the patient was without abdominal pain. Because of continued nausea and vomiting, the patient was referred to the Psychology Clinic with a diagnosis of nervous vomiting. The patient received sulpiride tablets,

Table 1. Treatment course after patient diagnosed with barium-induced intestinal obstruction

Treatment course \ Days after admission	Day one	Day two	Day three	Day four
Symptoms and signs	Nausea and vomiting Tenderness of lower abdomen Weak bowel sounds	Nausea and vomiting Abdominal pain Tenderness of lower abdomen Weak bowel sounds	Nausea and vomiting, abdominal distension Soft abdomen, no tenderness Weak bowel sounds	Nausea and vomiting Soft abdomen, no tenderness Weak bowel sounds
Examination method	Abdominal enhanced CT (**Figure 1**)	Abdominal plain film after enema (**Figure 2A**)	Abdominal plain film as after defecation (**Figure 2B**)	Abdominal plain film as after defecation (**Figure 2C**)
Treatment	Transferred to emergency ward Potassium = 3.22 mmol/L	Antacids: pantoprazole Potassium supplement = 3.0 mmol/L Enema: soapy water Gastrointestinal peristalsis promotion: Mosapride Laxative: lactose and fructose	Antacids: pantoprazole Potassium supplement = 2.52 mmol/L Enema: soapy water Gastrointestinal peristalsis promotion: Mosapride Laxative: lactose and fructose Suppositories: Glycerol	Antacids: pantoprazole Potassium supplement = 3.12 mmol/L Enema: soapy water Gastrointestinal peristalsis promotion: Mosapride Laxative: lactose and fructose Suppositories: Glycerol

Table 2. Summary of literature cases and the current case

Year	Gender	Age	Interval between barium application and intestinal obstruction	Obstruction Site and Complication	Treatment	Ref. #
1980	Female	66	2 weeks	Sigmoid colon	Surgery	[1]
1985	Female	60	5 months	Cecum	Surgery	[2]
1989	Male	73	2 days	Colon	Enema	[3]
1990	Male	58	12 months	Sigmoid colon	Surgery	[4]
1992	Female	76	8 months	Cecum	Surgery	[5]
1993	Female	84	16 months	Descending colon	Surgery	[6]
1994	Male	69	6 days	Descending colon	Colonoscopy	[7]
1995	Female	71	12 months	Sigmoid colon	Conservative treatment	[8]
1995	Male	39	2 days	Small intestine	Conservative treatment	[9]
1995	Male	25	Unknown	Left colon	Colonoscopy	[10]
1997	Female	54	10 days	Sigmoid colon-Perforation during colonoscopy for stone removal	Surgery	[11]
1997	Male	72	1 month	Whole colon	Surgery	[12]
1998	Female	70	6 weeks	Sigmoid colon	Surgery	[13]
1999	Female	83	6 months	Small intestine	Surgery	[14]
2003	Female	86	12 months	Sigmoid colon	Surgery	[15]
2006	Female	64	8 months	Sigmoid colon	Colonoscopy	[16]
2008	Female	79	2 weeks	Sigmoid colon-Perforation, peritonitis	Surgery	[17]
2014	Female	39	7 days	Sigmoid colon	Colonoscopy	[18]
2015	Female	86	1 week	Descending colon	Surgery	[19]
2016	Female	39	20 days	Colon	Conservative treatment	Current case

100 mg, bid, and was discharged after the symptoms improved (**Table 1**).

Literature review

Source of cases

The current study used “barium”, “obstruction”, “bowel obstruction”, “barolith” and “intestinal obstruction” as keywords to search for related cases in PubMed and MEDLINE from 1980-2016, with language restricted to English. We identified nineteen cases [1-19] (**Table 2**).

Case information

Among the reported cases, there were 7 male and 14 female patients with an age range of 25-86 years, who had intestinal obstruction 2 days-to-2 years after a barium examination.

The symptoms were mainly nausea and vomiting, abdominal pain, abdominal distension, and constipation. Four patients recovered after conservative treatment, 4 underwent endoscopic dissolution therapy, and the other 11 patients underwent surgical treatment after failed conservative treatment or complications with resection of necrotic bowel or colon lithotomy.

Discussion

Barium sulfate is a double-contrast agent that is used during X-ray examination. It is a high-density gastrointestinal contrast agent that can be made into different proportions of a suspension and used alone, but is usually used together with a low-density gas to achieve the purpose of double-contrast radiography. Barium sulfate can be administered by enema or orally. Due to the relatively high atomic number of barium, absorption of radiation is higher than the surrounding tissues, thus allowing better imaging of anatomic details. A barium swallow can evaluate the gastroesophageal junction and a barium meal can be used to study the gastric antrum and duodenum, while barium tracking can evaluate small intestine function [20]. A barium enema can facilitate the diagnosis of intestinal tumors and inflammatory diseases. An examination involving barium is still a common clinical examination method due to the convenience and economic efficacy, and thus still plays an important role in clinical practice. A "barolith" is a mixture of concentrated barium and stool, which can lead to various complications, such as intestinal volvulus, intussusception, colonic obstruction, ulcer, perforation, and appendicitis according to the different locations in the gastrointestinal system [21]. Although intestinal obstruction caused by barium retention is rare, considering its seriousness, clinicians must be vigilant. Because of the lack of relevant clinical guidelines, no standard treatment exists for barium-induced intestinal obstruction.

The cause of barium-induced intestinal obstruction may be that barium is nearly non-absorbable by the intestinal tract with high viscosity and a strong convergence effect. These properties of barium can result in retention, concentration, and accumulation in the gastrointestinal tract, and even mix with stool to form baroliths if intestinal peristalsis is weak, thus obstructing the intestinal cavity. The surface of baroliths is rough, which causes friction and damage along the intestinal wall. Because baroliths are hard, baroliths can press against the intestinal wall and lead to intestinal necrosis or perforation. If barium does not pass through the abdominal cavity in a timely manner, removal is difficult due to absorption of water and adhesion to the surrounding tissues. Because the surface of a barolith is not smooth, it can become a breeding site for bacteria and other pathogens, leading to severe local and systemic infections, or even toxic shock.

Based on the literature, we found that barium retention usually occurs in the left colon [22] for the following reasons: 1. The anatomic structure of the colon is smaller in diameter progressing from the proximal end to the end of the sigmoid colon. The diameter at the proximal end is approximately 6 cm, diminishing to the narrowest section at the junction of the rectosigmoid colon, where its diameter is as small as 2.5 cm. Therefore, the rectosigmoid colon is a common site for barium retention. 2. After forming a barolith at the proximal end, barium can descend through the intestinal tract by peristalsis and continuously mix with fecal luminal contents that are accumulated into the mass. The barolith thus becomes larger, evolving from incomplete intestinal obstruction at the proximal end to complete obstruction at the distal end.

Based on the literature, the risk factors for barium-induced intestinal obstruction are older age, electrolyte disorders, dehydration, intestinal stenosis, medications, and diseases with a change in intestinal motility (diabetes, Parkinson's disease, systemic lupus erythematosus, systemic sclerosis, and inflammatory bowel disease) [19]. In the current case, constipation and abnormal intestinal motility were factors. The decrease of intestinal motility was aggravated by concurrent mental illness and hypokalemia caused by frequent nausea and vomiting, which may have contributed to formation of the obstruction. In nearly all of the cases reported in the literature, the disease onset included nausea and vomiting, abdominal pain, abdominal distension, and constipation, while fever and diarrhea were relatively rare.

Barolith-induced intestinal obstruction can be diagnosed by X-ray or CT examination in combi-

nation with a history of barium contrast agent administration. We found that the incidence of barium-induced intestinal obstruction has not decreased over time with the progress of technology, even with the development and application of colonoscopy. For patients without clear indications for emergency surgery, conservative treatment options, such as enemas, laxatives, gastrointestinal motility improvement, and massage by hand, can be attempted. If the barolith cannot be discharged, colonoscopic litholysis can be attempted. Successful colonoscopic treatment cases reported in the literature have involved high-pressure water flushing, mechanical decomposition or a combination of the two under anesthesia [22]. If colonoscopic litholysis fails due to close adhesion between the barolith and the intestinal wall, or acute complications (intestinal perforation, strangulated intestinal obstruction, or narrow intestinal necrosis), surgery should be performed in a timely manner. Intestinal perforation and other emergency surgical indications did not occur in most of the cases in the literature that adopted the surgical option. In these cases, surgical treatment was undertaken because the longer the barium retention time, the more likely the barolith and intestinal wall will form an adhesion with resulting inflammation. Once adhesions are formed, the condition cannot be resolved by conservative treatment and there is an increased risk of perforation if colonoscopic litholysis is used. Our overall conclusion is that the indications for surgical treatment of the barolith are broad and cannot be stated categorically.

Barolith-induced intestinal obstruction is a rare complication of examinations using barium contrast agents. However, due to the serious consequences attendant to a failure to pass the barium, clinicians should pay close attention to high-risk groups, such as patients with constipation, weakened intestinal motility, general weakness and complicating diseases. Clinicians should fully weigh the pros and cons of the examination, and ask patients to maintain a normal diet, drink more water to promote barium flow, as well as prescribe a light laxative agent to promote barium discharge, thus avoiding the long residence time of the barium agent in the sigmoid colon with the consequent risk of intestinal obstruction. When intestinal obstruction occurs, appropriate treatment should be chosen based on the patient's symptoms, signs, and auxiliary examination results.

Acknowledgements

Research was supported by Liaoning Natural Science Foundation of China 201202268. English language editing performed by Expert English Services http://www.expertenglishservices.com.

Disclosure of conflict of interest

None.

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