Randomized trial

Randomized clinical study of Gastrografin® administration in patients with adhesive small bowel obstruction

S. Biondo, D. Parés, L. Mora, J. Martí Ragué, E. Kreisler and E. Jaurrieta

Department of Surgery, Hospital Universitario de Bellvitge, University of Barcelona, Barcelona, Spain
Correspondence to: Dr S. Biondo, Colorectal Unit, Department of Surgery, Hospital Universitario de Bellvitge, C/Feixa Llarga s/n, L'Hospitalet de Llobregat 08907, Barcelona, Spain (e-mail: sbiondo@csub.scs.es)

Background: Oral Gastrografin® has been used to differentiate partial from complete small bowel obstruction (SBO). It may have a therapeutic effect and predict the need for early surgery in adhesive SBO. The aim of this study was to determine whether contrast examination in the management of SBO allows an early oral intake and reduces hospital stay.

Methods: Eighty-three patients admitted between February 2000 and November 2001 with 90 episodes of symptoms and signs suggestive of postoperative adhesive SBO were randomized into two groups, a control group and Gastrografin® group. Patients in the control group were treated conservatively. If symptoms of strangulation developed or the obstruction did not resolve spontaneously after 4–5 days, a laparotomy was performed. Patients in the Gastrografin® group received 100 ml Gastrografin®. Those in whom the contrast medium reached the colon in 24 h were considered to have partial SBO, and were fed orally. If Gastrografin® failed to reach the colon and the patient did not improve in the following 24 h a laparotomy was performed.

Results: Conservative treatment was successful in 77 episodes (85·6 per cent) and 13 (14·4 per cent) required operation. Among patients treated conservatively, hospital stay was shorter in the Gastrografin® group ($P < 0·001$). All patients in whom contrast medium reached the colon tolerated an early oral diet. Gastrografin® did not reduce the need for operation ($P = 1·000$). No patient died in either group.

Conclusion: Oral Gastrografin® helps in the management of patients with adhesive SBO and allows a shorter hospital stay.

Paper accepted 21 January 2003
Published online in Wiley InterScience (www.bjs.co.uk). **DOI:** 10.1002/bjs.4150

Introduction

Although postoperative intraperitoneal adhesions are the most common cause of small bowel obstruction (SBO) in adults[1,2], considerable controversy exists regarding the recommended therapeutic strategy. To prevent the risk of strangulation, some authors recommend surgery for any patient with complete intestinal obstruction and reserve conservative treatment for patients with partial obstruction[3]. Moreover, a delay in surgical treatment of more than 24 h increases the complication rate and prolongs postoperative hospital stay[4]. Others suggest that patients with complete or partial postoperative SBO may be managed conservatively for 5 days, provided there are no obvious signs of intestinal strangulation[5].

The diagnosis of adhesive SBO is usually not difficult to make, but the inability to differentiate partial from complete obstruction accurately has led to conflicting opinions. Complete intestinal obstruction is usually defined as the complete inability to pass stool or flatus and the absence of gas distal to the site of obstruction on a plain abdominal film, but this definition is impractical[6]. Oral Gastrografin® (Schering, Berlin, Germany), a water-soluble contrast medium, has been used to differentiate partial from complete SBO[7]. It has also been shown to have a therapeutic effect and to predict the need for early surgery in adhesive SBO[8,9]. However, others observed that contrast examination did not contribute to the resolution of SBO[10].

The aim of this prospective randomized trial was to study the ability of Gastrografin® to resolve SBO, in terms of allowing early oral intake and reducing hospital stay. A further aim was to determine whether monitoring small

bowel transit with oral Gastrografin® helps to differentiate partial from complete SBO and is a reliable indicator of the need for operation.

Patients and methods

All patients admitted from February 2000 to November 2001 with symptoms and signs suggestive of postoperative SBO were considered for inclusion in the trial. The diagnosis was based on a clinical picture of abdominal pain, distension, vomiting and abnormal bowel sounds. The first plain abdominal radiograph was taken to confirm the presence of dilated small bowel loops and air–fluid levels. As described by Brolin[3], SBO was considered partial if there was gas in the colon. The absence of gas in the large intestine defined a complete obstruction, and so patients who had undergone subtotal or total colectomy previously were excluded. The Ethics Committee for Medical Research approved the study protocol and written informed consent was obtained from all the patients.

Exclusion criteria were: age below 18 years, pregnancy, allergy to iodine, known non-specific inflammatory bowel disease, symptoms suggestive of strangulating obstruction (fever, tachycardia, continuous pain with peritoneal irritation, metabolic acidosis), obstruction complicating an infective intra-abdominal process such as diverticular disease, known abdominal cancer, previous treatment with abdominal radiotherapy, intestinal obstruction within the first 4 weeks after an abdominal operation, known or suspected intestinal vascular disorder, previous subtotal colectomy and incarcerated abdominal wall hernia. All patients in whom the final diagnosis was not SBO were also excluded.

All patients were treated with intravenous fluids and a nasogastric tube. Electrolytes and acid–base imbalances were corrected as required. Patients entered in the study were randomized into control and Gastrografin® groups. Patients in the control group were followed clinically and with repeated abdominal radiography until the obstruction resolved, as judged by an improved radiographic appearance or the passage of flatus and stools. If symptoms of strangulation developed or the obstruction did not resolve spontaneously after 4–5 days, a laparotomy was performed.

In Gastrografin® group, after the clinical and radiological diagnosis had been made and written informed consent obtained, 100 ml Gastrografin® was administered to each patient through the nasogastric tube after complete suction of the gastric fluid in the emergency department. The nasogastric tube was then clamped for a period of 3 h. Abdominal radiography was repeated after 24 h. Patients in whom plain radiographs demonstrated contrast medium in the colon after 24 h were considered to have partial SBO, and were given a liquid diet followed by a soft diet. Patients in whom Gastrografin® failed to reach the colon after 24 h were considered to have complete SBO and

Table 2 Number and type of operations prior to small bowel obstruction

	Control	Gastrografin®	*P*
No. of previous operations*	1·8(0·9) (1–4)	1·9(1·0) (1–5)	0·814†
Type of previous surgery			0·940‡
Appendicectomy	15	18	
Colonic surgery	7	12	
Vagotomy and pyloroplasty	8	8	
Cholecystectomy	7	8	
Gastric surgery	7	6	
Gynaecological surgery	6	3	
Vascular surgery	3	2	
Hepatobiliopancreatic surgery	2	2	
Other	17	18	

*Values are mean(s.d.) (range). Other operations included exploratory laparotomy, incisional hernia, splenectomy, intestinal resection, adhesiolysis and urological surgery. †Student *t* test; ‡ANOVA.

Table 1 General characteristics of the two groups

	Control (46 episodes)	Gastrografin® (44 episodes)	*P*
Sex ratio (M : F)	28 : 18	33 : 11	0·180†
Age (years)*	65·6(14·2) (23–91)	60·0(15·5) (24–86)	0·081‡
Associated medical problems (%)	29 (64·4)	29 (69·0)	0·820†
Radiological findings (%)			0·290†
Partial small bowel obstruction	28 (60·5)	21 (47·7)	
Complete small bowel obstruction	18 (39·1)	23 (52·3)	

*Values are mean(s.d.) (range). Associated medical problems included hypertension, chronic obstructive pulmonary disease, cardiac disease, insulin-dependent diabetes, immunocompromised status, chronic renal insufficiency, previous malignant neoplasm, liver cirrhosis, morbid obesity, brain stroke. †χ^2 test; ‡Student *t* test.

Table 3 Overall outcome

	Control (46 episodes)	Gastrografin® (44 episodes)	*P*
Non-operative treatment	38	39	0·552†
Surgical treatment (%)	8 (17·4)	5 (11·4)	
Adhesiolysis	6	4	
Intestinal resection	2	1	1·000†
Time between admission and operation (days)*	4·7(1·2) (4–7)	2·0(6·7) (1–3)	0·002‡
Readmission	5	2	0·430†
Hospital stay (days)*	8·5(9·4) (3–55)	4·1(4·0) (1–23)	< 0·001‡

*Values are mean(s.d.) (range). †χ^2 test; ‡Student *t* test.

underwent laparotomy if there was no clinical or radiological improvement in the following 24 h. The predictive value of contrast examination in determining the need for operation was compared with that of the first plain abdominal film.

The following data were collected for each patient: age, sex, type of previous operation, associated medical problems, readmission, time between admission and surgical operation, outcome of treatment and hospital stay. A power analysis, done before starting the study, showed that to assure a significance level of 0·05 and a power of 80 per cent, 50 patients were needed in each group to detect a difference in the reduction of the hospital stay between the two groups of at least 2 days. Qualitative data were analysed by χ^2 test or ANOVA, and Student *t* test was used to compare quantitative data. $P \leq 0{\cdot}050$ was considered significant.

Results

In total, 94 patients, representing 102 episodes, fulfilled the inclusion criteria for the study. Two patients refused to enter the trial, so 100 hundred episodes in 92 patients were randomized into two groups. Ten episodes in nine patients were excluded from the study because the final diagnosis was not SBO, four episodes in the control group (one bezoar, one disseminated peritoneal gastric cancer, two colonic cancer) and six in the Gastrografin® group (three bezoar, one disseminated peritoneal gastric cancer, two pancreatitis). There were 46 episodes in 41 patients in the control group, and 44 episodes in 42 patients in the Gastrografin® group.

The groups did not differ significantly in sex ratio, age, associated medical problems and radiological criteria of partial and complete SBO, according to the first plain abdominal radiograph (*Table 1*). No significant differences were observed in the number and type of previous operations in the two groups (*Table 2*). Differences in non-operative treatment, number and type of operations, time between admission and operation, readmission rate and overall hospital stay between the two groups are reported in *Table 3*. Overall, conservative treatment was successful in 77 (85·6 per cent) of the obstructive episodes. Thirteen episodes (14·4 per cent) failed to respond, and the patients underwent operation, which confirmed complete SBO in all cases.

Of episodes that required surgical treatment, four of eight episodes in the control group were identified as partial SBO and four as complete SBO on the first plain abdominal radiograph, compared with two of five episodes diagnosed as partial SBO and three as complete SBO in the Gastrografin® group. According to radiological criteria after contrast examination, 39 episodes in the Gastrografin® group resulted from partial SBO and five from complete SBO. In this group, all patients whose plain abdominal film after 24 h showed contrast medium in the colon tolerated early oral feeding and had successful conservative treatment. All five patients with complete SBO were operated on, and a complete closed loop was confirmed during the operation.

In patients who responded to conservative treatment the mean(s.d.) hospital stay was 5·8(1·7) (range 3–11) days in the control group and 2·8(0·9) (range 1–5) days in the Gastrografin® group ($P < 0{\cdot}001$); that in patients who had an operation was 21·1(18·1) (range 10–55) and 13·6(5·6) (range 8–23) days respectively. No patient died in either group.

Discussion

SBO is a common cause of hospital admission, but significant controversy still surrounds the appropriate treatment. A delay in surgical treatment may lead to an increased mortality rate, from 3–5 per cent when the obstruction is simple, to about 30 per cent when it

is strangulated or when the bowel becomes necrotic or perforated[11].

Different methods have been used to predict which patients will best benefit from non-operative treatment. Recent reports have indicated that abdominal computed tomography and ultrasonography may improve the diagnostic accuracy for bowel strangulation, increasing the safety of conservative treatment. Moreover, computed tomography is able to detect the cause of obstruction as well as the presence of a closed loop[12–14].

Barium and water-soluble contrast medium have also been used to evaluate postoperative adhesion obstruction[3,15,16]. Some authors suggest that barium may be dangerous in cases of nearly complete obstruction, as it may thicken upstream of the level of the obstruction, and recommend the use of Gastrografin® because it is non-toxic in the peritoneal cavity[7]. In the latter trial, the presence of contrast medium in the colon within 8 h of ingestion as an indicator for non-operative treatment had a sensitivity of 90·2 per cent, specificity 100 per cent, accuracy 93·1 per cent, positive predictive value 100 per cent and negative predictive value 81·0 per cent[7]. The data did not confirm that failure of contrast medium to reach the colon within 8 h was an indication for surgery. In a previous study[9], the same authors showed that 24 h was long enough for Gastrografin® to reach the ascending colon and, therefore, for a decision to be made on the appropriate treatment. Accordingly, taking into account the logistics of the department of radiology, it was considered that a 24-h period would ensure that all patients would follow the same radiological sequence, and was appropriate for safe clinical management.

Based on the assumption that all patients with complete SBO will require an operation, and that those with partial obstruction will not, the results of the study indicated that plain abdominal radiography is not sensitive enough to discern between partial and complete SBO in patients with an uncertain degree of occlusion. The first plain abdominal film suggested the need for an operation in 18 of 46 episodes in control group and 23 of 44 in the Gastrografin® group, while only eight and five operations respectively were undertaken in the two groups. In contrast, the predictive value in the Gastrografin® group was 100 per cent after administration of contrast medium. All 39 episodes of partial SBO were treated non-operatively, and all five episodes of complete SBO needed an operation for a complete closed loop, which was confirmed during the operation.

Few comparative randomized studies have been published on the effect of Gastrografin® on adhesive SBO. Assalia *et al.*[8] observed that water-soluble oral contrast promoted and hastened the resolution of SBO, but had no significant effect on the incidence of operation. These authors only studied patients with partial SBO, based on Brolin criteria[3]. Feigin *et al.*[17] observed that, although water-soluble contrast was safe and useful in the diagnostic process, it did not offer advantages as a supplement to the usual conservative treatment of postoperative SBO. Fevang *et al.*[10], in a randomized study, observed that the use of a mixture of Gastrografin® and barium in patients with adhesive SBO did not resolve the obstruction. In contrast with the authors' experience, in a recent randomized trial[18] Gastrografin® reduced the need for surgery by 74 per cent. However, the significance of these results is questionable because of the randomization criteria used in the study.

The main finding of the present study was that the decisions based on the administration of water-soluble oral contrast helped significantly in the management of SBO, leading to a shorter hospital stay and good tolerance to an early oral soft diet. Gastrografin® did not reduce the number of episodes that needed operation and more patients may be required to determine the effect of Gastrografin® on operation rates. No differences were observed regarding the time to readmission and the readmission rate, but the time between admission and operation was longer in the control group. It is possible that radiography contributed to the diagnosis of complete SBO in the Gastrografin® group and thus led to an earlier operation. All five patients in this group were operated on because they did not improve after contrast examination. Contrast did not worsen the patient's symptoms in any case.

Oral Gastrografin® is safe and facilitates a more reliable diagnosis of complete SBO than a plain radiograph. It permits a change in the management of SBO that helps in its resolution with a shorter hospital stay. All patients with adhesive SBO in whom the contrast reaches the colon in 24 h may be successfully treated non-operatively.

References

1 McEntee G, Pender D, Mulvin D, McCullough M, Naeeder S, Farah S *et al.* Current spectrum of intestinal obstruction. *Br J Surg* 1987; **74**: 976–980.
2 Richards WO, Williams LF Jr. Obstruction of the large and small intestine. *Surg Clin North Am* 1988; **68**: 355–376.
3 Brolin RE. Partial small bowel obstruction. *Surgery* 1984; **95**: 145–149.
4 Fevang BT, Fevang J, Stangeland L, Søreide O, Svanes K, Viste A. Complications and death after surgical treatment of small bowel obstruction: a 35-year institutional experience. *Ann Surg* 2000; **231**: 529–537.

5 Seror D, Feigin E, Szold A, Allweis TM, Carmon A, Nissan S *et al*. How conservatively can postoperative small bowel obstruction be treated? *Am J Surg* 1993; **165**: 121–126.
6 Brolin RE, Krasna MJ, Mast BA. Use of tubes and radiographs in the management of small bowel obstruction. *Ann Surg* 1987; **206**: 126–133.
7 Chen SC, Chang KJ, Lee PH, Wang SM, Chen KM, Lin FY. Oral urografin in postoperative small bowel obstruction. *World J Surg* 1999; **23**: 1051–1054.
8 Assalia A, Schein M, Kopelman D, Hirshberg A, Hashmonai M. Therapeutic effect of oral Gastrografin® in adhesive, partial small-bowel obstruction: a prospective randomized trial. *Surgery* 1994; **115**: 433–437.
9 Chen SC, Lin FY, Lee PH, Yu SC, Wang SM, Chang KJ. Water-soluble contrast study predicts the need for early surgery in adhesive small bowel obstruction. *Br J Surg* 1998; **85**: 1692–1694.
10 Fevang BT, Jensen D, Fevang J, Søndenaa K, Øvrebø K, Røkke O *et al*. Upper gastrointestinal contrast study in the management of small bowel obstruction. A prospective randomised study. *Eur J Surg* 2000; **166**: 39–43.
11 Ellis H. The clinical significance of adhesions: focus on intestinal obstruction. *Eur J Surg Suppl* 1997; **577**: 5–9.
12 Balthazar EJ. George W. Holmes Lecture. CT of small-bowel obstruction. *AJR Am J Roentgenol* 1994; **162**: 255–261.
13 Fukuya T, Hawes DR, Lu CC, Chang PJ, Barloon TJ. CT diagnosis of small bowel obstruction: efficacy in 60 patients. *AJR Am J Roentgenol* 1992; **158**: 765–769.
14 Gazelle GS, Goldberg MA, Wittenberg J, Halpern EF, Pinkney L, Mueller PR. Efficacy of CT in distinguishing small-bowel obstruction from other causes of small-bowel dilatation. *AJR Am J Roentgenol* 1994; **162**: 43–47.
15 Hofstetter SR. Acute adhesive obstruction of the small intestine. *Surg Gynecol Obstet* 1981; **152**: 141–144.
16 Ericksen AS, Krasna MJ, Mast BA, Nosher JL, Brolin RE. Use of gastrointestinal contrast studies in obstruction of the small and large bowel. *Dis Colon Rectum* 1990; **33**: 56–64.
17 Feigin E, Seror D, Szold A, Carmon M, Allweis TM, Nissan A *et al*. Water-soluble contrast material has no therapeutic effect on postoperative small-bowel obstruction: results of a prospective, randomized clinical trial. *Am J Surg* 1996; **171**: 227–229.
18 Choi HK, Chu KW, Law WL. Therapeutic value of Gastrografin® in adhesive small bowel obstruction after unsuccessful conservative treatment: a prospective randomized trial. *Ann Surg* 2002; **236**: 1–6.

If you wish to comment on this, or any other article published in the *BJS*, please visit the on-line correspondence section of the website (www.bjs.co.uk). Electronic communications will be reviewed by the Correspondence Editor and a selection will appear in the correspondence section of the Journal. Time taken to produce a thoughtful and well written letter will improve the chances of publication in the Journal.