

Hartmann's Pouch: Radiographic Evaluation of Postoperative Findings

Ravi Cherukuri¹
Marc S. Levine¹
Daniel D. Maki¹
Stephen E. Rubesin¹
Igor Laufer¹
Ernest F. Rosato²

OBJECTIVE. The purpose of this study was to determine the usefulness of contrast-enhanced radiography of the Hartmann's pouch for evaluating postoperative abnormalities.

MATERIALS AND METHODS. We performed a retrospective study of 84 patients with a Hartmann's pouch who underwent contrast-enhanced radiography of the pouch during a recent 7-year period. Sixty-four patients underwent single-contrast barium studies of the pouch, 17 underwent studies with a water-soluble contrast medium, and three underwent both types of studies. The radiographic studies were reviewed to determine the types and frequency of abnormalities involving the pouch. Medical records were also reviewed to determine clinical presentation and course.

RESULTS. Abnormalities of the Hartmann's pouch were detected on contrast-enhanced radiography in 16 (19%) of the 84 patients. Of the 70 patients who underwent routine contrast-enhanced radiography of the pouch, 11 (16%) had abnormalities, including diversion colitis in three, leaks in two, adhesions in two, recurrent carcinoma in two, ulcerative colitis involving the pouch in one, and a stricture in one. In both patients with clinically silent leaks, the contrast-enhanced radiography was performed 3 months or more after creation of the pouch. Of the remaining 14 patients who underwent contrast-enhanced radiography because of suspected complications involving the pouch, five (36%) had abnormalities revealed, including leaks in two, fistulas in two, and recurrent carcinoma in one.

CONCLUSION. Contrast-enhanced radiography of the Hartmann's pouch revealed abnormalities of the pouch in 19% of patients, including leaks or fistulas, diversion colitis, adhesions, strictures, and recurrent tumor. Because two patients had clinically silent leaks that were detected during the late postoperative period, it may be prudent to perform these studies with a water-soluble contrast medium to avoid the problems associated with extravasation of barium into the extra- or intraperitoneal spaces.

The Hartmann's procedure is a common surgical procedure in which a temporary diverting colostomy and blind-ending rectal or colonic stump closed by suture (Hartmann's pouch) are created after partial colectomy or sigmoidectomy [1]. This procedure is usually performed on an emergent basis in patients with complicated diverticulitis, obstructing or perforated sigmoid carcinoma, or penetrating trauma [2, 3]. When such patients undergo sigmoid resection, a Hartmann's procedure is performed rather than primary reanastomosis of the bowel because of the risk of anastomotic rupture associated with inadequate bowel preparation, complicating peritonitis, or both. The creation of a tempo-

rary diverting colostomy allows peritoneal inflammation to subside; the colostomy can then be taken down and reanastomosed to the pouch during the second stage of the procedure to restore colonic continuity.

Leakage or even blowout of the blind-ending rectal or colonic stump can occur as a potentially life-threatening complication of the Hartmann's procedure [4-7]. Other complications include pouch fistulas or strictures and diversion colitis [4, 8, 9]. Contrast-enhanced radiography of the Hartmann's pouch may be performed to assess the anatomy and integrity of the pouch and to rule out complications before takedown of the colostomy. To our knowledge, except for two previous articles about diversion colitis [10, 11], little

Received April 29, 1998; accepted after revision June 11, 1998.

¹Department of Radiology, Hospital of the University of Pennsylvania, 3400 Spruce St., Philadelphia, PA 19104. Address correspondence to M. S. Levine.

²Department of Surgery, Hospital of the University of Pennsylvania, Philadelphia, PA 19104.

AJR 1998;171:1577-1582

0361-803X/98/1716-1577

© American Roentgen Ray Society

data exist in the radiology literature concerning the usefulness of contrast-enhanced radiography for evaluating the Hartmann's procedure or its complications. The purpose of this study was to determine the findings of contrast-enhanced radiography of the Hartmann's pouch in a large series of patients who underwent this surgical procedure.

Materials and Methods

Patient Population

We performed a retrospective study of 84 patients with a Hartmann's pouch who underwent contrast-enhanced radiography of the pouch at our university hospital or affiliated Veterans Affairs hospital during a 7-year period between 1990 and 1997. The patients included 58 male patients and 26 female patients with an average age of 51 years (range, 15–85 years). The indications for creating a Hartmann's pouch are summarized in Table 1. The proximal diverting colostomy was subsequently taken down and reanastomosed to the pouch in 63 patients (75%). Excluding one patient in whom the colostomy was taken down 25 years after the first stage of the procedure, the average interval between creation of the Hartmann's pouch and takedown of the colostomy was 8 months (range, 2–42 months). In all cases, medical records were reviewed to determine the clinical presentation and course of these patients.

Radiographic Studies

Each of the 84 patients underwent contrast-enhanced radiography of the Hartmann's pouch, including single-contrast barium studies in 64 patients, studies with water-soluble contrast medium in 17 patients, and both in three patients. Ex-

cluding the one patient in whom a Hartmann's pouch was created 25 years earlier, the average duration between creation of the pouch and contrast-enhanced radiography was 10 months (range, 1–67 months). Seventy patients (83%) underwent routine examinations to assess the anatomy of the pouch before takedown of the colostomy. The remaining 14 patients (17%) underwent contrast-enhanced radiography to rule out postoperative abnormalities because of abdominal pain and fever in four patients, abdominal pain and diarrhea in one, abdominal pain alone in two, diarrhea and fever in one, diarrhea alone in two, fever alone in two, rectal pain in one, and a pelvic mass on CT in one. In these 14 patients, the average duration between creation of the pouch and contrast-enhanced radiography was 12 months (range, 1–42 months).

Radiographic examination of the Hartmann's pouch was performed using the following technique: An anteroposterior scout film of the abdomen and pelvis was initially obtained. A Foley catheter was then inserted via the anus into the pouch, and either barium sulfate or a water-soluble contrast medium (Hypaque [diatrizoate sodium]; Nycomed, Princeton, NJ; or Gastroview [diatrizoate meglumine and diatrizoate sodium]; Mallinckrodt Medical, St. Louis, MO) was introduced into the pouch under fluoroscopic guidance. Radiographic imaging of the pouch included spot films of the pelvis in frontal, lateral, and oblique projections; frontal and lateral overhead radiographs of the pelvis; and a lateral postevacuation radiograph of the pelvis to assess functional emptying of the pouch.

The original radiology reports from all 84 patients were reviewed to determine the findings of contrast-enhanced radiography of the pouch. The radiographs from 78 examinations (including all the studies showing abnormalities described in the radiology reports) were reviewed retrospectively.

In those 78 cases, the blind-ending Hartmann's pouch was found to extend as far as the proximal rectum or rectosigmoid junction in six patients (8%), the sigmoid colon in 61 (78%), the descending colon in eight (10%), and the transverse colon in three (4%). In six patients with normal findings on postoperative studies, the radiographs were not available for review.

Results

Postoperative Studies with Normal Findings

Sixty-eight patients (81%) who underwent contrast-enhanced radiography of the Hartmann's pouch had normal findings on postoperative studies. Of these 68 patients, 41 (60%) had an uncomplicated takedown of the diverting colostomy; 14 (21%) had takedown of the colostomy complicated by postoperative wound infections ($n = 7$), abscesses ($n = 3$), or anastomotic leaks ($n = 4$) that necessitated surgical or percutaneous drainage; six (9%) did not have takedown of the colostomy for various medical reasons; and the remaining seven (10%) were lost to follow-up.

Abnormalities of the Pouch

Abnormalities were detected on contrast-enhanced radiography of the Hartmann's pouch in 16 (19%) of 84 patients (Table 2). Of 70 patients who underwent routine contrast-enhanced radiography before takedown of the colostomy, 11 (16%) had abnormalities, including diversion colitis in three, leaks in two, adhesions in two, recurrent carcinoma in two, ulcerative colitis involving the pouch in one, and a stricture in one. Of the other 14 patients

Indication	Patients	
	No.	%
Complicated diverticulitis	41	49
Gunshot wound	15	18
Perforated sigmoid carcinoma	9	11
Pericolic abscess	5	6
Inflammatory bowel disease	3	4
Ischemic bowel disease	3	4
Atonic megacolon	2	2
Steroid-related bowel perforation	2	2
Metastatic ovarian carcinoma	1	1
Iatrogenic trauma	1	1
Colonic varices	1	1
Obstructing neurofibroma	1	1

Findings	Routine Radiography		Radiography for Suspected Complications		Total	
	No.	%	No.	%	No.	%
Abnormal findings						
Leaks or fistulas	2	2	4	5	6	7
Diversion proctitis	3	4	0	0	3	4
Ulcerative proctitis	1	1	0	0	1	1
Recurrent carcinoma	2	2	1	1	3	4
Adhesions	2	2	0	0	2	2
Strictures	1	1	0	0	1	1
Total abnormalities	11	13	5	6	16	19
Normal findings	59	70	9	11	68	81
Total no. of patients	70	83	14	17	84	100

Radiography of Hartmann's Pouch

who underwent contrast-enhanced radiography because of suspected complications involving the pouch, five (36%) had abnormalities, including leaks in two, fistulas in two, and recurrent carcinoma in one.

Leaks or Fistulas

Of six patients with leaks or fistulas from the Hartmann's pouch, two were asymptomatic; these two underwent routine barium studies of the pouch before planned takedown of the colostomy. In one of the asymptomatic patients, a study 3 months after creation of the pouch showed focal extravasation of barium from the proximal end of the pouch into a 6×3 cm collection in the presacral space (Fig. 1). In the second patient, a study 7 months after creation of the pouch showed free extravasation of barium from the blind end of the sigmoid pouch into the peritoneal cavity (Fig. 2). The first patient underwent surgical revision of the pouch and subsequent takedown of the colostomy; the second was admitted to the hospital for 5 days of IV antibiotic therapy and was scheduled for surgical revision and takedown of the colostomy.

In four patients (e.g., abdominal pain, fever, or

leukocytosis), studies with water-soluble contrast media showed leaks or fistulas involving the pouch. One of these patients had a 2.5-cm tract from the posterior wall of the rectal pouch into a tiny collection in the presacral space; a second had focal extravasation from the end of a long transverse colonic stump into a sealed-off 5-cm collection (Fig. 3); and a third had an enterocutaneous fistula from the anterior border of the pouch to the anterior abdominal wall. After treatment with antibiotics, these three patients had successful closure of the colostomy. In the fourth patient, a study with water-soluble contrast medium showed a long fistula between the right superolateral border of the rectosigmoid pouch and the distal ileum. The fistula was repaired surgically.

Diversion Colitis

In three asymptomatic patients, barium studies of the pouch revealed diversion colitis, a distinct pathologic entity involving the pouch in which nonspecific inflammatory changes occur in colonic segments diverted from the fecal stream [12]. In all three patients, marked narrowing of the pouch was noted. In addition, the pouch had a nodular, spiculated contour in two of these patients (Fig. 4) and a smooth, featureless appearance

in one. The latter patient was found at sigmoidoscopy to have findings of diversion colitis, with erythema and friability of the pouch. The other two patients did not undergo endoscopy; one had an uncomplicated takedown of the pouch and was subsequently lost to follow-up, and the other was not a candidate for a takedown procedure because of his overall health.

Ulcerative Colitis Involving Pouch

One patient developed a pericolic abscess after resection of a retroperitoneal sarcoma, necessitating a partial left hemicolectomy and creation of a Hartmann's pouch. The patient had rectal bleeding 6 months later and underwent sigmoidoscopy. Endoscopic biopsy specimens revealed findings compatible with ulcerative colitis involving the pouch rather than diversion colitis. The patient was treated with steroid enemas, and his symptoms resolved. Follow-up contrast-enhanced radiography of the pouch 6 months later showed continued proctitis with thickened, edematous folds in the pouch.

Adhesions

In one asymptomatic patient, a barium study of the pouch revealed beaklike narrow-

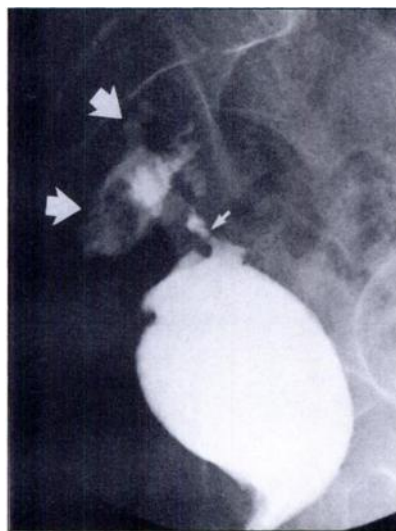


Fig. 1.—56-year-old asymptomatic woman with focal leak from Hartmann's pouch. Barium study shows extravasation (small arrow) from proximal end of pouch into 6×3 cm collection (large arrows) in presacral space.

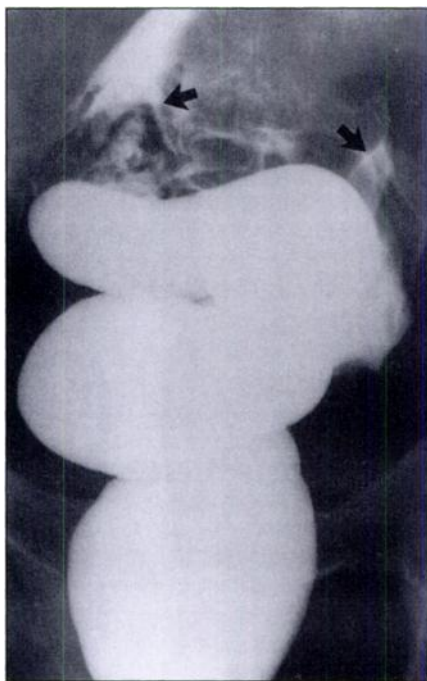


Fig. 2.—55-year-old asymptomatic man with free leak from Hartmann's pouch into peritoneal cavity. Barium study shows extravasation of barium from blind end of sigmoid pouch into peritoneum. Note how intraperitoneal barium outlines loops of bowel (arrows) in pelvis.

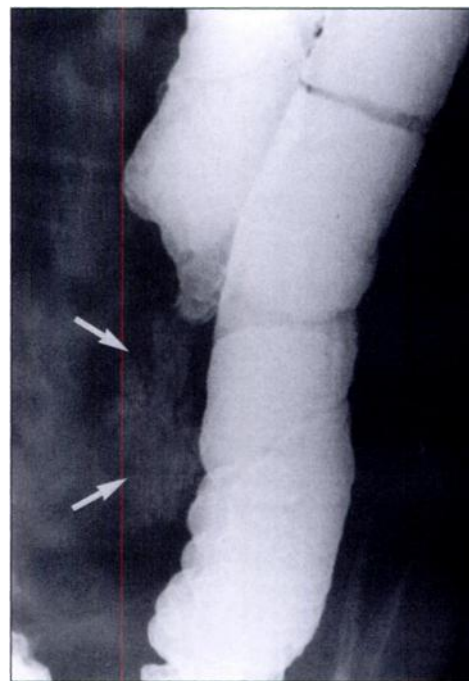
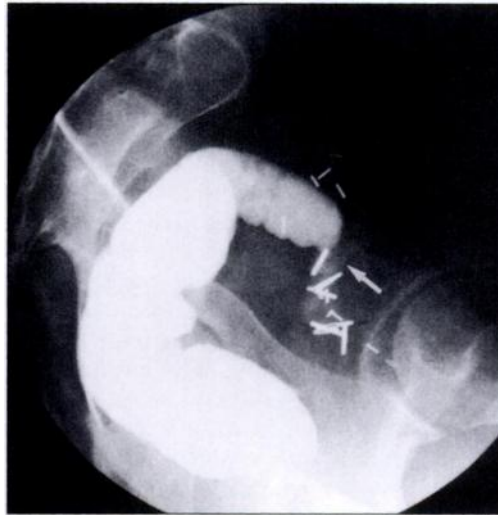


Fig. 3.—51-year-old woman with focal leak from Hartmann's pouch. Contrast-enhanced radiograph with water-soluble contrast medium shows extravasation from end of long transverse colonic stump into sealed-off 5-cm collection (arrows). Patient presented with clinical signs (e.g., fever and leukocytosis) of leak.



4



5

Fig. 4.—44-year-old man with diversion colitis. Barium study shows marked narrowing of Hartmann's pouch, which has nodular, spiculated contour.

Fig. 5.—23-year-old man with pelvic adhesions simulating leak. Barium study shows amorphous 2-cm collection of barium (arrow) adjacent to tip of Hartmann's pouch. This collection was thought to be suggestive of small, sealed-off leak. At surgery, however, rectal stump was found to be entrapped by dense pelvic adhesions without evidence of breakdown of staple line.

ing of the proximal end of the rectal stump; this abnormality was found at surgery to be caused by dense pelvic adhesions. The adhesions were lysed, and the colostomy was taken down without complication. In another asymptomatic patient, a barium study revealed an amorphous 2-cm collection of barium adjacent to the tip of the pouch (Fig. 5) that was thought to be suggestive of a small, sealed-off leak from the staple line. However, no leak was found at surgery; instead, it was found that the rectal stump was entrapped by multiple pelvic adhesions, presumably accounting for the radiographic findings. This patient also underwent lysis of adhesions and successful takedown of the colostomy.

Strictures

In one patient, a study 25 years after creation of the pouch showed a smooth, tapered stricture

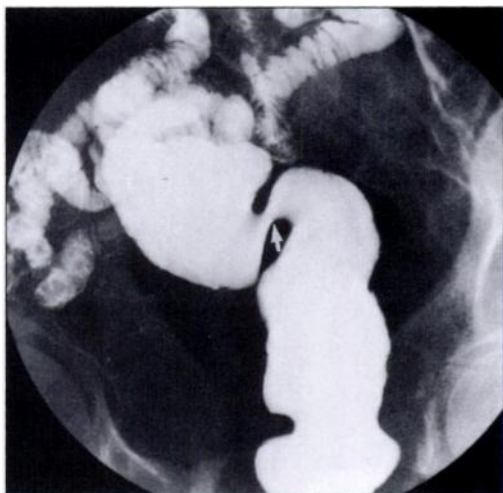
at the rectosigmoid junction, with a surgically created side-to-side ileosigmoid anastomosis between the proximal end of the pouch and a diverted segment of blind-ending ileum (Fig. 6). The cause of the stricture was uncertain, but it could have been related to scarring from prior surgery or to chronic ischemic changes involving the pouch. Subsequently, this patient had successful takedown of the colostomy with resection of the proximal end of the pouch and blind-ending ileal segment.

Recurrent Carcinoma

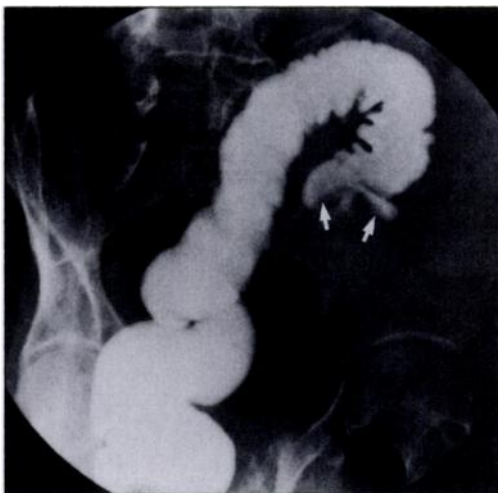
In three patients, contrast-enhanced radiography revealed involvement of the Hartmann's pouch by recurrent carcinoma. Two of these patients were asymptomatic. In one, a routine barium study of the pouch revealed an annular, obstructing lesion near the tip of the stump (Fig. 7), which was resected at the time the

colostomy was taken down; the resected lesion was found on pathologic examination to be recurrent colonic carcinoma. In the second asymptomatic patient, a routine barium study revealed a 2-cm area of extrinsic mass effect on the anterior border of the rectosigmoid pouch. This patient was found at surgery to have intraperitoneal seeded metastases to the pouch from recurrent colonic carcinoma, and the colostomy was not taken down.

The remaining patient had known metastatic ovarian carcinoma. In this patient, a barium study of the pouch was performed to assess the extent of tumor in the pelvis; the study revealed a large area of extrinsic mass effect on the anterior border of the rectosigmoid pouch. An exploratory laparotomy confirmed the presence of widely disseminated tumor in the pelvis, and the diverting colostomy was not taken down.



6



7

Fig. 6.—69-year-old man with stricture involving Hartmann's pouch. Barium study shows smooth tapered stricture (arrow) involving proximal end of pouch. Barium is seen to reflux into blind-ending segment of ileum via surgically created ileosigmoid anastomosis (not shown).

Fig. 7.—68-year-old man with recurrent carcinoma involving Hartmann's pouch. Barium study shows annular obstructing lesion (arrows) near tip of stump. This lesion was found at surgery to be caused by recurrent colonic carcinoma.

Discussion

Routine contrast-enhanced radiography of the Hartmann's pouch is often requested by the surgeon to assess the anatomy and integrity of the pouch before takedown of the proximal diverting colostomy. Many radiologists erroneously believe that the pouch consists of a blind-ending rectal or rectosigmoid stump. In fact, the Hartmann's pouch is defined in the surgical literature as a rectal or colonic stump that can extend as far proximally as the transverse colon [1, 13, 14]. In our series, the Hartmann's pouch extended beyond the level of the sigmoid colon in 14% of patients. The length of the pouch is of particular interest to the surgeon because the stump can slowly shorten over time, affecting its location in relation to the proximal diverting colostomy [5]; this information is important when planning the surgical technique to take down the colostomy and reanastomose the proximal colon to the pouch.

The most important cause of morbidity and mortality after the first stage of the Hartmann's procedure is breakdown of the rectal stump [4, 8]. In various series, the rate of leakage from the Hartmann's pouch has ranged from 2% to 9% [4-7]. Most such leaks involve the blind end of the oversewn stump (Figs. 1-3). Depending on the location of the stump, these leaks can be extraperitoneal or intraperitoneal. Patients with short rectal stumps may have extraperitoneal leaks with associated pelvic abscesses. In such patients, options for treatment include antibiotics, percutaneous or surgical drainage of the abscess, or surgical repair of the leak. In contrast, patients with long pouches may have intraperitoneal leaks from the blind-ending stump, with abscess formation or even peritonitis. When peritonitis occurs, surgical repair of the leak usually is required because of the life-threatening nature of this complication [15].

Surprisingly, it is difficult to find guidelines about the appropriate use of contrast agents for radiologic evaluation of the Hartmann's pouch. In general, water-soluble contrast media (e.g., Hypaque or Gastroview) are used to rule out leaks from the pouch during the early postoperative period (i.e., days to weeks after surgery), whereas barium sulfate is used to evaluate the pouch during the late postoperative period (i.e., months to years after surgery).

In our study, however, two of six patients with breakdown of the pouch had clinically silent leaks (Figs. 1 and 2) that were detected

3 months or more after creation of the pouch. One of the leaks was extraperitoneal (Fig. 1) and the other was intraperitoneal (Fig. 2). Both patients were asymptomatic, presumably because the pouch had been diverted from the fecal stream; the leaks therefore occurred in a relatively sterile environment. Clinically silent leaks or fistulas have also been shown to occur from an ileal pouch after total proctocolectomy and ileoanal pull-through with a diverting ileostomy [16]. In such patients, delayed closure of the ileostomy has been advocated to allow time for healing before exposing the ileal pouch to the fecal stream [16, 17]. Similarly, delaying takedown of the colostomy in patients with asymptomatic leaks from the Hartmann's pouch should allow these leaks to heal, decreasing the risk of pelvic infection after colonic continuity has been restored.

Some investigators believe that peritonitis occurs only as a complication of barium studies in patients with perforated bowel when barium and feces simultaneously enter the peritoneal cavity [18, 19]. However, animal experiments have shown that even aseptic administration of intraperitoneal barium may cause peritonitis [20]. The use of barium sulfate to evaluate the Hartmann's pouch could also compromise follow-up studies in patients with leaks because barium (unlike water-soluble contrast medium) is not resorbed from the extra- or intraperitoneal spaces. For these reasons, we favor the use of water-soluble contrast media for radiographic evaluation of the Hartmann's pouch even during the late postoperative period because clinically silent leaks occasionally may be found in these patients.

When evaluating the esophagus for possible perforation, esophagography with barium sulfate can detect leaks that are missed with water-soluble contrast media [21]. Therefore, it is recommended that esophagography be repeated with barium sulfate when no leak is detected with water-soluble contrast media in patients with suspected esophageal perforation [21]. In theory, a similar approach could be used to evaluate the Hartmann's pouch with contrast-enhanced radiography. However, many patients would be unable or unwilling to tolerate two sequential contrast-enhanced examinations of the pouch (i.e., a study with water-soluble contrast medium immediately followed by a barium study), and it would be difficult to obtain optimal barium coating of a pouch that contained residual water-soluble contrast medium. Therefore, this approach would be impractical for most patients.

When a high level of clinical suspicion exists of a pelvic abscess in a patient with a Hartmann's pouch or when a leak from the pouch is shown on contrast-enhanced radiography, CT is the imaging technique of choice for confirming the presence of an abscess and determining its extent [4, 15]. Depending on the size and location of the abscess, it can be drained surgically or percutaneously with CT guidance.

Some patients with a Hartmann's pouch may develop diversion colitis, a nonspecific inflammatory process occurring in colonic segments that have been diverted from the fecal stream [12]. It has been postulated that diversion colitis is caused by a deficiency of short-chain fatty acids, which normally are used by the colonic mucosa for nutrition [22]. Diversion colitis may be extremely difficult to differentiate from Crohn's colitis on pathologic grounds [23]. In our series, diversion colitis was manifested by decreased distensibility and nodularity of the pouch on barium studies (Fig. 4). Others have previously described a nodular mucosa on double-contrast examinations of the pouch, most likely due to lymphoid follicular hyperplasia of the excluded colonic segment [10, 11]. Diversion colitis is a relatively common condition at endoscopy, but most of these patients are asymptomatic [12, 23]. In almost all cases, diversion colitis spontaneously remits after the diverting colostomy has been taken down and colonic continuity restored [12, 23, 24].

Although uncommon, dense pelvic adhesions may prevent complete filling of the Hartmann's pouch. Rarely, contrast medium in the deformed pouch may erroneously suggest a leak, as occurred in one of our patients (Fig. 5). When the Hartmann's procedure is performed on patients with sigmoid carcinoma or other pelvic malignancies, contrast-enhanced radiography may show involvement of the pouch by recurrent tumor in the pelvis (Fig. 7).

Several investigators have reported cases of primary rectal carcinoma developing in a Hartmann's pouch one or more years after surgery for benign disease [8, 25, 26]. It has been postulated that chronic inflammation of the pouch in patients with diversion colitis increases the risk of malignant degeneration [26]. These investigators therefore advocate periodic evaluation of the pouch with endoscopy or contrast-enhanced radiography, even in asymptomatic patients, so that developing cancers can be detected at the earliest possible stage [8, 25, 26]. However, long-term fol-

low-up of a large series of patients with Hartmann's pouches is required to determine whether the incidence of rectal carcinoma is increased in these patients.

In summary, contrast-enhanced radiography of the Hartmann's pouch revealed abnormalities of the pouch in 16 (19%) of 84 patients, including leaks or fistulas, diversion colitis, adhesions, strictures, and recurrent tumor. Because two patients had clinically silent leaks that were detected during the late postoperative period, it may be prudent to perform these studies with water-soluble contrast medium to avoid the problems associated with extravasation of barium into the extra- or intraperitoneal spaces.

References

1. Corman ML. Diverticular disease. In: Corman ML, ed. *Colon and rectal surgery*, 3rd ed. Philadelphia: Lippincott, 1993:817-859
2. Wedell J, Banzhaf G, Chaoui R, Fischer R, Reichmann J. Surgical management of complicated colonic diverticulitis. *Br J Surg* 1997;84:380-383
3. Doci R, Audisio RA, Bozzetti F, Gennari L. Actual role of Hartmann's resection in elective surgical treatment of carcinoma of rectum and sigmoid colon. *Surg Gynecol Obstet* 1986;163:49-53
4. Carter FM, McLeod RS, Cohen Z. Subtotal colectomy for ulcerative colitis: complications related to the rectal remnant. *Dis Colon Rectum* 1991;34:1005-1009
5. Chua CL. Surgical considerations in the Hartmann procedure. *Aust N Z J Surg* 1996;66:676-679
6. Lubbers EJC, de Boer HMM. Inherent complications of Hartmann's operation. *Surg Gynecol Obstet* 1982;155:717-721
7. Bakker FC, Hoitsma HFW, Den Otter G. The Hartmann procedure. *Br J Surg* 1982;69:580-582
8. Haas PA, Fox TA. The fate of the forgotten rectal pouch after Hartmann's procedure without reconstruction. *Am J Surg* 1990;159:106-111
9. Oakley JR, Lavery IC, Fazio VW, Jagelman DG, Weakley FL, Easley K. The fate of the rectal stump after subtotal colectomy for ulcerative colitis. *Dis Colon Rectum* 1985;28:394-396
10. Lechner GL, Wolfgang F, Jantsch H, et al. Lymphoid follicular hyperplasia in excluded colonic segments: a radiologic sign of diversion colitis. *Radiology* 1990;176:135-136
11. Scott RL, Pinstein ML. Diversion colitis demonstrated by double-contrast barium enema. *AJR* 1984;143:767-768
12. Glotzer DJ, Glick ME, Goldman H. Proctitis and colitis following diversion of the fecal stream. *Gastroenterology* 1981;80:438-441
13. Rosenman LD. Hartmann's operation: how I do it. *Am J Surg* 1994;168:283-284
14. Nunes GC, Robnett AH, Kremer RM, Ahlquist RE. The Hartmann procedure for complications of diverticulitis. *Arch Surg* 1979;114:425-429
15. Schein M, Kopelman D, Nitecki S, Hashimonai M. Management of the leaking rectal stump after Hartmann's procedure. *Am J Surg* 1993;15:285-287
16. Hrun JM, Levine MS, Rombau JL, Rubesin SE, Laufer I. Total proctocolectomy and ileoanal pouch: the role of contrast studies for evaluating postoperative leaks. *Abdom Imaging* 1998;23:375-379
17. Alfischer MM, Scholz FJ, Roberts PL, Counihan T. Radiology of ileal pouch-anal anastomosis: normal findings, examination, pitfalls, and complications. *RadioGraphics* 1997;17:81-98
18. Yamamura M, Nishi M, Furubayashi H, Hioki K, Yamamoto M. Barium peritonitis: report of a case and review of the literature. *Dis Colon Rectum* 1985;28:347-352
19. Grobmeyer AJ, Kerlan RA, Peterson CM, Dragstedt LR. Barium peritonitis. *Am Surg* 1984;50:116-120
20. Henrich MH. Barium peritonitis in animal experiments. *Chirurg* 1986;57:801-804
21. Buecker A, Wein BB, Neuerburg JM, Guenther RW. Esophageal perforation: comparison of use of aqueous and barium-containing contrast media. *Radiology* 1997;202:683-686
22. Sartor RB, Murphy ME, Rydzak E. Miscellaneous inflammatory and structural disorders of the colon. In: Yamada T, ed. *Textbook of gastroenterology*, 2nd ed. Philadelphia: Lippincott, 1995:1806-1832
23. Murray FE, O'Brien MJ, Birkett DH, Kennedy SM, Lamont JT. Diversion colitis: pathologic findings in a resected sigmoid colon and rectum. *Gastroenterology* 1987;93:1404-1408
24. Scholz FJ. Postoperative colon. In: Gore RM, Levine MS, Laufer I, eds. *Textbook of gastrointestinal radiology*. Philadelphia: Saunders, 1994:1342-1350
25. Lafreniere R, Ketcham AS. Hartmann's pouch carcinoma. *J Surg Oncol* 1985;29:26-27
26. Thaemert BC, Kiskin WA. Neoplasms in long-term Hartmann's pouches. *Wis Med J* 1996;95:105-107