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REVIEW

Current indications for the Hartmann procedure

J. Barbieux*, F. Plumereau, A. Hamy

Service de chirurgie viscérale et endocrinienne, CHU d'Angers, 4, rue Larrey, 49100 Angers cedex 1, France

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Summary The Hartmann procedure is used in the case of left-sided colonic disease, especially in the setting of emergency where intraoperative conditions contraindicate completion of an anastomosis. This procedure has been initially described for the management of colorectal cancer and is based on a sigmoïdectomy without restoration of intestinal continuity, including a left-sided iliac terminal stoma and closure of the rectal stump. Both procedure and underlying risk factors explain high rates of mortality and morbidity, around 15 and 50% respectively, and a low overall rate of subsequent restoration of internal continuity, less than 50%. The purpose of this review was to evaluate the value of the Hartmann procedure and its equivalents in colonic surgery, according to its indications: colorectal cancer, peritonitis from diverticular disease, anastomotic complications, ischemic colitis, left-sided colonic volvulus and abdominal trauma.

Introduction

The Hartmann procedure was first described in 1923 by Henri Albert Hartmann (1869—1952) for the management of colorectal cancer [1]. It consists of a sigmoid colectomy without restoration of intestinal continuity; an end colostomy is brought out in the left lower quadrant and the rectal stump is closed. The objective of the Hartmann procedure was to reduce the morbidity and mortality of sigmoid colectomy for cancer, especially by avoiding colorectal anastomosis [2]. By extension, this use has gradually been extended to other left colon pathologies, especially in the emergency setting, where perioperative conditions contraindicate the performance of a colorectal anastomosis. This procedure is fast, simple and effective, and preserves the possibility of an eventual restoration of intestinal continuity. It is most often performed in the emergency setting when patient condition (hypotensive shock, need for damage-control laparotomy, ASA IV patients) or the condition

* Corresponding author.
E-mail address: julienbarbieux@hotmail.com (J. Barbieux).

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of intestinal tissue (severe inflammation, colonic obstruction with distension) makes the intervention difficult and increases the risk of postoperative complications [3]. In practice, the rate of restoration of intestinal continuity after Hartmann procedure remains low at less than 50% [2]. In fact, restoration of continuity has its own morbidity, which limits the indications; the mortality rate is close to 2% and morbidity is about 30% [4]. The objective of this review is to clarify the place of the Hartmann procedure in current practice of colonic surgery, based on a comprehensive literature search of the term, ''Hartmann procedure'', and analyzing all the series published in the last 20 years that included more than 10 patients, according to the surgical indications.

Hartmann Procedure for Colorectal Cancer

The Hartmann procedure was first described for the treatment of colorectal cancer with obstruction [1]. Since then, its indication for cancer has become limited (Table 1).

For scheduled cancer surgery, the use of the Hartmann procedure has become rare. Its indications are now well defined: cases of cancer of the colon and upper rectum with stricture or preocclusion but without signs of complication (perforation, parietal guarding, small bowel incarceration), palliative situations in patients with serious comorbidities or preexisting anal incontinence (with the alternative of endoscopic placement of an endoprosthesis for this indication) [5].

In the management of left colon obstruction, the role of the Hartmann procedure remains controversial. The French recommendations propose an initial diverting stoma allowing completion of diagnostic work-up, followed by early single-stage resection and anastomosis [6]. The recommendations of the ''World Society of Emergency Surgery'' advocate the Hartmann procedure for high-risk patients (as an alternative to diverting colostomy), citing the advantage of a shorter overall hospitalization period [7]. The study by Krstic et al., comparing the Hartmann procedure *vs.* diverting colostomy, found that the only significant difference was a longer hospital stay after diverting colostomy with second-stage resection/anastomosis during the same hospitalization [8]. Chéreau et al. reported more complications in patients treated with the Hartmann procedure, despite ASA scores similar to those of patients treated with diverting colostomy. However, in this series, the Hartmann procedure was preferred for cases of complicated colonic obstruction with perforation, which can constitute a significant bias [9]. The registry study by Kube et al. highlighted that resection/anastomosis with a proximal protective stoma had the same spectrum of complications as the Hartmann procedure, with a trend to more frequent systemic complications after Hartmann procedure, and a comparable rate of early reintervention [10].

The choice of therapeutic strategy should also take into account the prospect of adjuvant chemotherapy, particularly in patients with synchronous liver metastases. The choice of surgical intervention should not delay this systemic management [9].

Overall, poor general condition (hypotensive shock at the time of surgery, severe comorbidity, and advanced age (making the likelihood of any eventual reoperation for colectomy unlikely), or local complications (associated peritonitis) may contribute to making the Hartmann procedure the preferred or necessary surgical choice. Among the other options, initial decompressive colostomy followed by second-stage resection/anastomosis, or resection/anastomosis with a protective proximal stoma may be applicable to obstructed colorectal cancer when conditions are more favorable although each option has its own specific advantages and disadvantages [11].

When colorectal cancer is treated by the Hartmann procedure, restoration of intestinal continuity seems to be infrequent: in the series by Chéreau et al., fewer than 40% of patients with obstructed left colon cancer eventually underwent reversal and reanastomosis, but this series included only 11 patients [9]; other series in the literature are silent on this point [8,10].

Hartmann Procedure for perforated diverticulitis with peritonitis

The management of peritonitis associated with sigmoid diverticulitis has recently evolved, particularly since the advent of laparoscopy. The Hartmann procedure remains the simplest but most radical intervention; other options have been described such as resection/anastomosis with or without protective stoma [3], or laparoscopic lavage and drainage [12]. The meta-analysis by Cirocchi et al. published in 2013 noted the heterogeneity of management strategies despite a large literature on the subject, making it difficult to create a decision tree [13]. Laparoscopic lavage and drainage for complicated diverticulitis was first described by O'Sullivan et al. in 1996 [12]. This approach is contra-indicated in cases of fecal peritonitis, hemodynamic instability, or demonstration of uncontained perforation at surgery [3,13]. When confronted with these clinical findings, conversion to open laparotomy with performance of a Hartmann procedure is recommended [3]. In a Dutch meta-analysis published in 2010, the rate of failure for lavage and drainage was 4.3% [14]; mortality and morbidity of this procedure were 0—7.7%, and 2—11% respectively [14,15].

Laparoscopic lavage and drainage has been considered an appropriate option for Hinchey II complicated diverticular disease that is not amenable to radiology-guided drainage or for Hinchey III peritonitis in a hemodynamically stable patient [16]. However, these indications for laparoscopic lavage and drainage are controversial because of the significantly higher rate of reoperation (20%) during the initial hospitalization compared to immediately sigmoidectomy [17,18]. Overall, Hartmann's intervention would be most appropriate for Hinchey II disease that is not amenable to radiologic drainage or for Hinchey III peritonitis in a hemodynamically stable patient.

For purulent peritonitis, the possibility of single-stage resection/anastomosis has also been supported. The meta-analysis by Cirocchi et al. showed that the overall mortality rate was significantly lower after resection/anastomosis *vs.* the Hartmann procedure [13]; however, in terms of reoperation for complications, no significant difference was found between the two techniques [13]. Mueller et al. concluded that anastomotic leakage after initial resection/anastomosis was more often associated with a high ASA score than with the Hinchey stage per se [19].

In addition to the Hinchey classification, the choice of surgical technique must take into account the patient's general comorbidities. Currently, the World Society of