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Abdominal Drainage in the Prevention and Management of Major Intra-Abdominal Complications after Total Gastrectomy for Gastric Carcinoma

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Conflict of Interest
No potential conflict of interest relevant to this article was reported.

ABSTRACT

Purpose: The role of prophylactic abdominal drainage in total gastrectomy is not well-established. This study aimed to evaluate the efficacy of abdominal drainage in the prevention and management of major intra-abdominal complications after total gastrectomy for gastric carcinoma.
Materials and Methods: We retrospectively reviewed the data of 499 patients who underwent total gastrectomy for gastric carcinoma in a high-volume institution. The patients were divided into drainage and non-drainage groups and compared for the development and management of major intra-abdominal complications, including anastomotic leak, abdominal bleeding, abdominal infection, and pancreatic fistulas.
Results: The drainage group included 388 patients and the non-drainage group included 111 patients. The 2 groups showed no significant differences in clinicopathological characteristics or operative procedures, except for more frequent D2 lymphadenectomies in the drainage group. After surgery, the overall morbidity (drainage group vs. non-drainage group: 24.7% vs. 28.8%, P=0.385) and incidence of major intra-abdominal complications (6.4% vs. 6.3%, P=0.959) did not significantly differ between the two groups. The non-drainage group showed no significant increase in the incidence rate of major intra-abdominal complications in the subgroups divided by age, sex, comorbidity, operative approach, body mass index, extent of lymphadenectomy, and pathological stage. Abdominal drainage had no significant impact on early diagnosis, secondary intervention or reoperation, or recovery from major intra-abdominal complications.
Conclusions: Prophylactic abdominal drainage showed little demonstrable benefit in the prevention and management of major intra-abdominal complications of total gastrectomy for gastric carcinoma.

Keywords: Drainage; Gastrectomy; Morbidity

INTRODUCTION

Despite its decreasing global incidence, gastric cancer is one of the most frequent types of malignancies and is the leading cause of cancer-related deaths in East Asia [1]. With the increasing incidence of proximal gastric cancer, the use of total gastrectomy is becoming

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more prevalent in the surgical management of gastric carcinoma. Total gastrectomy is regarded as a relatively risky procedure with considerable perioperative morbidities, such as anastomotic leak, duodenal stump leak, and development of intra-abdominal infection [2]. Therefore, early detection and management of postoperative complications are essential to reduce morbidity and mortality rates.

Prophylactic abdominal drainage has long been commonplace in gastrointestinal surgery to aid in the prevention and management of abdominal complications. However, the role of abdominal drainage has recently been questioned, and several studies have found abdominal drainage to have no significant benefits in gastrointestinal surgery. A meta-analysis of 17 randomized controlled trials (RCTs) of liver resection, colorectal surgery, cholecystectomy, and appendectomy found level I evidence indicating that abdominal drainage had no clinical benefits in the prevention of postoperative complications [3]. In this context, the evidence-based guidelines of the Enhanced Recovery After Surgery (ERAS) Society strongly recommend avoiding the use of abdominal drains, particularly in colorectal surgery [4] and gastrectomy [5]. However, prophylactic abdominal drainage is widely performed after gastrectomy in actual clinical practice [6]. A recent Korean nationwide survey showed that approximately 70% of gastric surgeons routinely inserted abdominal drains after gastrectomy for gastric carcinoma [7].

The role of abdominal drainage in total gastrectomy is not well-established. Only a few RCTs have investigated the efficacy of abdominal drainage after gastrectomy [8-10]. In a meta-analysis of these RCTs, it was found that abdominal drainage did not reduce postoperative morbidity and mortality, but instead prolonged postoperative hospital stays and led to drain-related complications [11]. However, these studies included mixed types of gastrectomy and had limitations typical of small, single-institution studies. One RCT, which investigated 60 patients who underwent total gastrectomy, showed significantly higher morbidity and longer hospital stays in patients with abdominal drains [10]. Many surgeons believe that the use of abdominal drainage after total gastrectomy is justified, considering the potentially life-threatening complications, such as anastomotic leak. However, the available information is insufficient to determine the efficacy of abdominal drainage. In this study, we investigated the effects of abdominal drainage on the prevention and management of major abdominal complications in patients who underwent total gastrectomy for gastric carcinoma.

MATERIALS AND METHODS

Patients and data

Using our gastric cancer database, we retrospectively reviewed the data of 2,708 consecutive patients who underwent surgery for gastric carcinoma between January 2010 and December 2017 at Chonnam National University Hwasun Hospital, South Korea. The inclusion criterion was patients who underwent total gastrectomy for gastric carcinoma. Of the 512 eligible patients, 13 with incomplete medical records were excluded, leaving a total of 499 patients included in the study. We divided the patients into 2 groups according to whether abdominal drainage was performed (drainage and non-drainage groups), and compared the development and management of major intra-abdominal complications between the 2 groups. Our Institutional Review Board approved this study and waived the requirement for obtaining informed consent.

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The patients' clinicopathological data and postoperative outcomes were prospectively collected from our gastric cancer database. We retrieved demographic data (age, sex, body mass index, American Society of Anesthesiologist physical status, and comorbidity), operative results (surgical approach, lymphadenectomy, combined organ resection, operating time, and operative bleeding), pathological results (tumor location, macroscopic type, histologic differentiation, and pathological stage), and postoperative outcomes (hospital stay, diet start, gas passage, morbidity, mortality, and readmission) from the database.

The primary outcome in this study was major intra-abdominal complications, including abdominal infection, anastomotic leak, abdominal bleeding, and pancreatic fistula. We investigated the incidence, detection time, treatment modalities, and recovery time of the major intra-abdominal complications in the two groups. Treatment modalities were classified as conservative, interventional (radiological or endoscopic), or operative. Recovery time was defined as the time from the development of complications to hospital discharge.

The pathological stage was based on the eighth edition of the Union of International Cancer Control tumor node metastasis classification [12]. Tumor characteristics and operative outcomes were described on the basis of the third edition of the Japanese classification of gastric carcinoma [13]. Postoperative morbidity and mortality were defined as complications or death within 30 days of the operation. Postoperative complications were classified as local or systemic according to their sites of development. The severity of postoperative complications was graded using the Clavien-Dindo classification of surgical complications [14].

Operative procedure and insertion of abdominal drainage

Two experienced gastric surgeons (OJ and SYR) performed all operations. The operative techniques, including gastric resection and lymphadenectomy, followed the general rules of the gastric cancer treatment guidelines [15]. The decision regarding whether to perform open or laparoscopic surgery was made at the discretion of the surgeons on the basis of preoperative staging. In principle, laparoscopic surgery was indicated for cT1-2 or cN0 tumors. After gastric resection, a conventional Roux-en-Y esophagojejunostomy was performed in all patients.

The decision regarding insertion of an abdominal drain was made according to the surgeon's preference. Surgeon A (SYR) routinely performed abdominal drainage after surgery, while Surgeon B (OJ) did not. In the drainage group, a closed abdominal drain was placed around the anastomotic site and supra-pancreatic area. The drain was removed 4–5 days after surgery, when it showed a clean nature and a total drainage volume of <50–100 mL. The two groups received the same postoperative management, such as postoperative oral nutrition, intravenous fluid management, pain control, and criteria for hospital discharge.

Statistical analyses

Data are expressed as mean±standard deviation or number (percentage). Categorical variables were compared using the χ^2 or Fisher's exact test, as appropriate, and continuous variables were compared using Student's *t*-test or the Mann-Whitney U test. All statistical analyses were performed using SPSS version 22.0 (IBM Corp., Armonk NY, USA). A P-value of <0.05 was considered statistically significant.

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RESULTS

Patient characteristics

The drainage group included 388 patients and the non-drainage group included 111 patients. The clinicopathological characteristics of the two groups are presented in **Table 1**. The study participants included 353 men and 146 women with a mean age of 62.2±12.0 years, and a total of 273 individuals (54.7%) had comorbidities. Open and laparoscopic surgeries were performed in 302 (60.5%) and 197 patients (39.5%), respectively. D2 lymphadenectomy was performed in 174 patients (34.9%). The final pathological examination revealed 247 stage I cases (49.5%), 88 stage II cases (17.6%), 118 stage III cases (23.6%), and 46 stage IV cases (9.2%). The 2 groups showed no significant differences in clinicopathological characteristics, except for the more frequent D2 lymphadenectomies in the drainage group (40.7% vs. 14.4%, P<0.001).

Table 1. Patient characteristics

Characteristics	All (n=499)	Non-drainage group (n=111)	Drainage group (n=388)	P-value
Age (yr)	62.2±12.0	62.9±12.0	62.1±12.0	0.797
Sex				0.719
Male	353 (68.5)	77 (69.4)	276 (71.1)	
Female	146 (28.3)	34 (30.6)	112 (28.9)	
BMI (kg/m^2)	23.2±3.3	22.9±2.9	23.3±3.4	0.288
Underweight (<18.5)	38 (7.4)	7 (6.3)	31 (8.0)	
Normal (18.5–24.9)	319 (61.9)	78 (70.3)	241 (62.1)	
Obesity (≥25)	142 (27.6)	26 (23.4)	116 (29.9)	
ASA physical status				0.125
1	147 (285)	37 (33.3)	110 (28.4)	
2	319 (61.9)	64 (57.7)	255 (65.7)	
3	33 (6.4)	9 (8.1)	23 (5.9)	
Comorbidity	273 (53.0)	61 (55.0)	212 (54.6)	0.953
Operative approach				0.133
Open	302 (58.6)	74 (66.7)	228 (58.8)	
Laparoscopy	197 (38.3)	37 (33.3)	160 (41.2)	
Lymphadenectomy				<0.001
D1+	325 (63.1)	95 (85.6)	230 (59.3)	
D2	174 (33.8)	16 (14.4)	158 (40.7)	
Combined organ resection	84 (16.3)	17 (15.3)	67 (17.3)	0.628
Tumor location				0.750
Lower third	326 (63.3)	6 (5.4)	20 (5.2)	
Middle third	121 (23.5)	30 (27.0)	91(23.5)	
Upper third	326 (63.3)	71 (64.0)	255 (65.7)	
Whole stomach	26 (5.0)	4 (3.6)	22 (5.7)	
Macroscopic type				0.867
Superficial	208 (40.4)	51 (45.9)	157 (40.5)	
Bormann 1	24 (4.7)	4 (3.6)	20 (5.2)	
Bormann 2	49 (9.5)	10 (9.0)	39 (10.1)	
Bormann 3	156 (30.3)	32 (28.8)	124 (32.0)	
Bormann 4	56 (10.9)	12 (10.8)	44 (11.3)	
Bormann 5	6 (1.2)	2 (1.8)	4 (1.0)	
Histological differentiation				0.197
Differentiated	468 (90.9)	107 (96.4)	361 (93.0)	
Undifferentiated	31 (6.0)	4 (3.6)	27 (7.0)	
TNM stage*				0.425
I	247 (48.0)	55 (49.5)	192 (49.5)	
II	88 (17.1)	22 (19.8)	66 (17.0)	
III	118 (22.9)	28 (25.2)	90 (23.2)	
IV	46 (8.9)	6 (5.4)	40 (10.3)	

Data are presented as mean±standard deviation or number (%).
ASA = American Society of Anesthesiologists; BMI = body mass index; TNM = tumor, node, metastasis.
*Eighth edition of the American Joint Committee on Cancer TNM classification of gastric carcinoma.

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Short-term surgical outcomes

Table 2 shows the short-term surgical outcomes of the 2 groups. The overall morbidities in the drainage and non-drainage groups were 24.7% and 28.8%, respectively (P=0.385). No significant difference in the incidence of local or systemic complications was found between the 2 groups. The incidence of major intra-abdominal complications did not significantly differ between the 2 groups (6.4% in the drainage group vs. 6.3% in the non-drainage group, P=0.959). The incidence rate of grade ≥3 intra-abdominal complications was 3.4% in the drainage group and 3.6% in the non-drainage group (P=0.897). No significant differences in postoperative blood transfusion, time to gas passage, length of postoperative hospital stay, or readmission rate were found between the 2 groups.

Subgroup analysis of intra-abdominal complications

Fig. 1 shows a comparison of major intra-abdominal complications between the drainage and non-drainage groups within the subgroups of different age, sex, comorbidity, operative

Table 2. Short-term surgical outcomes

Variables	Non-drainage group (n=111)	Drainage group (n=388)	P-value
Overall morbidity	32 (28.8)	96 (24.7)	0.385
Local complications	30 (27.0)	80 (20.6)	0.151
Systemic complications	9 (8.1)	22 (5.7)	0.348
Mortality	0	3 (0.8)	0.353
Major intra-abdominal complications	7 (6.3)	25 (6.4)	0.959
Abdominal bleeding	0	4 (1.0)	0.283
Abdominal infection	4 (3.6)	11 (2.8)	0.676
Anastomotic leak	1 (0.9)	5 (1.3)	0.741
Pancreatic fistula	2 (1.8)	5 (1.3)	0.685
Grade ≥3 major abdominal complications*	4 (3.6)	13 (3.4)	0.897
Postoperative blood transfusion	10 (9.0)	55 (14.2)	0.154
Gas passage (POD)	2.4±0.9	3.1±1.0	0.120
Hospital stay (POD)	10.9±14.6	9.7±5.9	0.212
Readmission†	4 (3.6)	10 (2.6)	0.585

Data are presented as mean±standard deviation or number (%).
POD = postoperative day
*Clavien-Dindo classification; †Readmission within 30 days after hospital discharge.

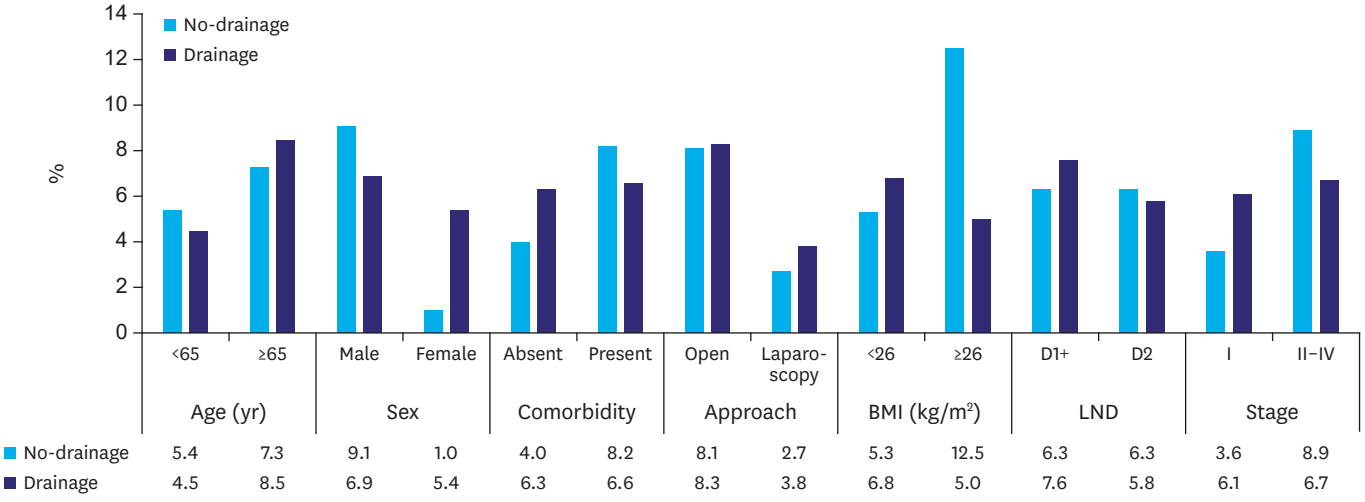

Fig. 1. Comparisons of major abdominal complications between the no-drainage and drainage groups in the subgroups according to various clinicopathological characteristics. The no-drainage group showed no significant increase in major abdominal complications in any subgroups analyzed.
BMI = body mass index; LND = lymph node dissection.

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Table 3. Diagnosis and management of major intra-abdominal complications

Variables	Non-drainage group (n=7)	Drainage group (n=25)	P-value*
Time to diagnosis (POD)	6.8±3.6	6.0±3.7	0.688
Treatment modalities			
Conservative treatment	3 (42.8)	13 (52.0)	1.000
Intervention	4 (57.1)	11 (44.0)	0.851
Reoperation	0	1 (4.0)	0.489
Mortality	0	1 (4.0)	0.489
Length of hospital stay (POD)	22.0±11.6	21.9±14.1	0.859
Discharge after developing complications	15.1±12.8	15.8±13.6	0.964

Data are presented as mean±standard deviation or number (%).
POD = postoperative day.
*Mann-Whitney U test or Fisher's exact test.

approach, body mass index, extent of lymphadenectomy, and pathological stage. The non-drainage group showed no significant increase in the incidence of major intra-abdominal complications as compared with the drainage group in all subgroups.

Diagnosis and management of major intra-abdominal complications

To evaluate the role of abdominal drainage in the diagnosis and management of intra-abdominal complications, we compared the detection time, treatment modality, and recovery time from complications between the 2 groups (**Table 3**). We found no significant difference in the detection time of complications between the drainage and non-drainage groups (6.0±3.7 vs. 6.8±3.6 postoperative days, P=0.688). As for the management of complications, the use of interventional treatment (radiological or endoscopic intervention) and the reoperation rate did not significantly differ between the 2 groups. The recovery time from complications also did not significantly differ between the 2 groups (15.8 days in the drainage group vs. 15.1 days in the non-drainage group, P=0.964).

DISCUSSION

The role of prophylactic drainage after total gastrectomy is uncertain. In this study, we investigated the effect of abdominal drainage on the prevention and management of major intra-abdominal complications of total gastrectomy. We found that abdominal drainage did not reduce the incidence of major intra-abdominal complications. Furthermore, abdominal drainage offered little benefit in the early diagnosis and management of intra-abdominal complications. Our results indicate that routine insertion of abdominal drains may not be necessary. Further research is required to determine the role of prophylactic drainage after total gastrectomy for gastric carcinoma.

The perspective regarding abdominal drainage after gastrectomy is somewhat different between the East and West. The guidelines of the ERAS Society strongly recommend avoiding the use of abdominal drains after gastrectomy [5]. However, abdominal drainage is still widely accepted in Asia, considering the differences in operative techniques, such as extended lymph node dissection between the East and West [6,7]. For postoperative management in gastric cancer surgery, the Japanese gastric cancer treatment guidelines recommend the use of abdominal drains and the removal of these drains before or on postoperative day 5 [15]. This difference is mostly due to the lack of convincing evidence regarding the necessity of abdominal drainage after gastrectomy for gastric carcinoma.

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In contrast to other abdominal surgeries, few studies have focused on prophylactic drainage in gastric surgery. Two RCTs that included a total of 278 patients treated with subtotal gastrectomy found no significant differences in postoperative outcomes, such as time to gas passage, start of diet, or length of hospital stay [8,9]. Postoperative morbidity was also similar between the 2 groups. A meta-analysis of four RCTs, which included 438 patients who underwent subtotal or total gastrectomy, revealed no significant differences between the drainage and non-drainage groups with respect to postoperative complications and length of hospital stay [11]. Although the current evidence suggests that abdominal drainage is ineffective in patients undergoing gastrectomy, the overall quality of the evidence is relatively inferior because of the small sample sizes, single-institution data, and inadequate study designs.

Owing to concerns regarding fatal complications, such as an esophagojejunal anastomotic leaks or intra-abdominal infection, many gastric surgeons adhere to the routine insertion of abdominal drains after total gastrectomy [7]. However, the safety and feasibility of using abdominal drains after total gastrectomy is not supported by emerging evidence. In an RCT that included 60 patients who underwent total gastrectomy, patients in the drainage group had longer hospital stays, higher postoperative morbidity, and more frequent reoperation [10]. In a multi-institutional analysis by the US Gastric Cancer Collaborative, which included 344 patients who underwent total gastrectomy, no significant difference was found in the incidence rates of any complications or 30-day mortality between the drainage and non-drainage groups [16]. Another small retrospective study that included 44 patients who underwent total gastrectomy showed similar results, demonstrating no significant differences in postoperative complications and length of hospital stay between the drainage and non-drainage groups [17]. Our study reaffirmed this in a large cohort of patients treated in a specialized high-volume institution. The strength of this study is that we also focused on the role of abdominal drainage in the early diagnosis and management of intra-abdominal complications, for which we found no demonstrable benefits. Owing to the retrospective design of our study, the results should be interpreted with caution because of possible selection bias. The role of prophylactic drainage in total gastrectomy must be further investigated in a large multi-institutional RCT.

In this study, we found that abdominal drainage did not reduce the postoperative morbidity and incidence rate of major intra-abdominal complications in general. However, abdominal drainage may be beneficial in some conditions, depending on the patient characteristics or operative factors. Therefore, we performed a subgroup analysis based on various demographic features and operative factors. We found that the non-drainage group showed no significant increase in the incidence of major abdominal complications in any of the subgroups analyzed. This implies that abdominal drainage can be safely omitted after total gastrectomy, regardless of the operative approach, extent of lymphadenectomy, or tumor stage.

Most previous studies have suggested that abdominal drainage is ineffective in preventing postoperative complications. However, some authors argue that abdominal drainage may be beneficial for the early diagnosis and management of surgical complications. In a study of 1,989 patients with gastric cancer, Lee et al. [18] showed that the incidence of postoperative catheter drainage significantly increased in patients without abdominal drainage. They insisted that abdominal drainage is not necessary in general, but the selective use of abdominal drainage may reduce the incidence of postoperative catheter drainage. In contrast, our study showed that the incidence of postoperative catheter drainage or reoperation did not significantly differ between the drainage and non-drainage groups. Furthermore, the detection time of intra-abdominal complications was also similar between the two groups.

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In most patients, careful assessment based on physical findings, laboratory results, and radiological findings can lead to swift diagnosis of intra-abdominal complications. Similarly, Schots et al. [19] reported that daily measurement of amylase concentration in abdominal drains did not influence the early recognition and management of leakage in gastric cancer surgery. This implies that abdominal drainage itself may not be useful in the early diagnosis and management of postoperative complications.

In this study, the decision regarding insertion of abdominal drains was made by a surgeon. Although Surgeon A did not insert abdominal drains in routine practice, insertion of abdominal drains was performed in some cases (n=3), at his discretion, if there was a concern about developing an anastomotic leak or bleeding. Therefore, although the number of these patients was small, there was a possibility of selection bias. In addition, the differences in the treatment strategy for surgical complications between surgeons might have also affected surgical outcomes.

Our study showed a relatively lower incidence of major abdominal complications, such as anastomotic leak (1.2%) or abdominal bleeding (0.8%), compared to other studies. This might downplay the efficacy of drain placement in preventing these complications. In this study, operations were performed by 2 experienced gastric surgeons who performed 150 to 250 gastrectomies per year. As a high-volume institution, we also had a well-organized multidisciplinary team for gastric cancer management. This might limit the generalizability of our results. Therefore, the feasibility of not using an abdominal drain needs to be further validated in a multi-institutional study.

This study has some limitations. First, the decision to perform abdominal drainage was made according to the surgeon's preference. Therefore, operative outcomes may have been affected by the surgeon's experience. However, the 2 surgeons in this study both had substantial experience in gastrectomy and followed the same operative principles and perioperative care routines. Therefore, the impacts of the surgeons' levels of experience on the operative outcomes would be minimal. Second, this study was performed in a high-volume institution with a specialized gastric cancer clinic, which could have limited the generalizability of our results. Lastly, as the incidence rate of each abdominal complication was relatively low, we could not perform a detailed analysis according to the type of complication. This might be more realistic in a large-scale study with multi-institutional data.

In conclusion, this study demonstrated that abdominal drainage after total gastrectomy had little benefit for improving the early detection of complications, reducing the need for secondary intervention or reoperation, or shortening the recovery time from major abdominal complications. Our results suggest that abdominal drainage can be safely omitted after total gastrectomy. However, further validation will be required because this study was performed in a high-volume institution with experienced gastric surgeons. A large RCT is warranted to determine the necessity of abdominal drainage after total gastrectomy for gastric carcinoma.

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