



Value of Primary Operative Drain Placement after Major Hepatectomy: A Multi-Institutional Analysis of 1,041 Patients

Malcolm H Squires III, MD, MS, Neha L Lad, MD, Sarah B Fisher, MD, MS, David A Kooby, MD, FACS, Sharon M Weber, MD, FACS, Adam Brinkman, MD, Juan M Sarmiento, MD, FACS, Charles R Scoggins, MD, MBA, FACS, Michael E Egger, MD, Kenneth Cardona, MD, FACS, Clifford S Cho, MD, FACS, Robert CG Martin, MD, PhD, FACS, Maria C Russell, MD, FACS, Emily Winslow, MD, FACS, Charles A Staley III, MD, FACS, Shishir K Maithel, MD, FACS

BACKGROUND: The value of routine primary (intraoperative) drain placement after major hepatectomy remains unclear. We sought to determine if primary drainage led to decreased rates of complications, specifically, intra-abdominal biloma or infection requiring a secondary (postoperative) drainage procedure.

STUDY DESIGN: All patients who underwent major hepatectomy (≥ 3 hepatic segments) at 3 institutions, from 2000 to 2012, were identified. Patients with biliary anastomoses were excluded. Primary outcomes were any complication, rate of secondary drainage procedures, bile leak, and 30-day readmission.

RESULTS: There were 1,041 patients who underwent major hepatectomy without biliary anastomosis; 564 (54%) had primary drains placed at the surgeon's discretion. Primary drain placement was associated with increased complications (56% vs 44%; $p < 0.001$), bile leaks (7.3% vs 4.2%; $p = 0.048$), and 30-day readmissions (16.4% vs 8.0%; $p < 0.001$), but was not associated with a decrease in secondary drainage procedures (8.0% vs 5.9%; $p = 0.23$). Patients with primary drains demonstrated higher American Society of Anesthesiologists (ASA) class, greater blood loss, more transfusions, and larger resections. After accounting for these significant clinicopathologic variables on multivariate analysis, primary drain placement was not associated with increased risk of any complications. Primary drainage was, however, independently associated with increased risk of bile leak (hazard ratio [HR] 2.04; 95% CI 1.02 to 4.09; $p = 0.044$) and 30-day readmission (HR 1.79; 95% CI 1.14 to 2.80; $p = 0.011$). There still was no reduction in the need for secondary drainage procedures (HR 0.98; $p = 0.96$).

CONCLUSIONS: Primary intraoperative drain placement after major hepatectomy does not decrease the need for secondary drainage procedures and may be associated with increased bile leaks and 30-day readmissions. Routine drain placement is not warranted. (*J Am Coll Surg* 2015;220:396–402. © 2015 by the American College of Surgeons)

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From the Division of Surgical Oncology, Department of Surgery, Winship Cancer Institute, Emory University, Atlanta, GA (Squires, Lad, Fisher, Kooby, Sarmiento, Cardona, Russell, Staley, Maithel); the Department of Surgery, University of Wisconsin School of Medicine and Public Health, Madison, WI (Weber, Brinkman, Cho, Winslow); and the Division of Surgical Oncology, Department of Surgery, University of Louisville, Louisville, KY (Scoggins, Egger, Martin).

Correspondence address: Shishir K Maithel, MD, FACS, Winship Cancer Institute, Division of Surgical Oncology, 1365C Clifton Rd NE, 2nd Floor, Atlanta, GA 30322. email: smaithe@emory.edu

Historically, prophylactic intraoperative peritoneal drain placement has been advocated after hepatectomy in order to identify and drain bile leaks and decrease the risk of potential perihepatic fluid collections and abscess formation postoperatively. Several small randomized trials have suggested, however, that routine abdominal drainage after elective liver resection may not be necessary.^{1–5} A systematic review of the 465 patients encompassed by these 5 randomized trials examining operative drainage after hepatectomy found no evidence to support routine drain placement.⁶ This meta-analysis did, however, demonstrate a trend toward a decreased rate of secondary percutaneous drainage procedures among patients who had

Abbreviations and Acronyms

ASA = American Society of Anesthesiologists
EBL = estimated blood loss
HR = hazard ratio

primary drains placed (3.6% vs 5.4%), though this difference did not reach statistical significance. Despite the results of these randomized trials, primary drains are still commonly placed in clinical practice after major hepatectomy. In addition, most of the patients included in these previous studies underwent minor hepatic resections of only 1 to 2 hepatic segments and many had pre-existing cirrhosis, potentially limiting the general applicability of these results to patients undergoing more extensive hepatic resections.¹⁻⁵ Given these limited data, questions remain regarding the need for drainage after major hepatectomy.

Whether primary operative drain placement decreases the likelihood of intra-abdominal fluid collections, such as bilomas and abscesses and the subsequent need for postoperative secondary drainage procedures, remains unresolved. We sought to determine the impact of intra-abdominal drainage on postoperative complications and the need for secondary drainage procedures in a large multi-institutional cohort of consecutive patients undergoing major hepatectomy without biliary anastomosis.

METHODS

All patients who underwent major hepatectomy, defined as resection of ≥ 3 hepatic segments, from January 2000 to July 2012 at 3 high-volume academic institutions, were identified from prospectively maintained surgical databases. Patients who underwent biliary-enteric anastomotic reconstruction were excluded from analysis. Institutional Review Board approval from each participating institution was obtained, and research activities were conducted in compliance with the Health Insurance Portability and Accountability Act of 1996.

Preoperative comorbidities, demographics, and basic preoperative laboratory values were gathered from the medical record. Operative details including the extent of hepatic resection, operative approach, drain placement, transfusion data, estimated blood loss (EBL), and pathology were recorded. Intra-abdominal placement of a closed drain at the time of operation was defined as "primary drain placement" and was at the discretion of the attending surgeon. All resections were performed with low central venous pressure anesthesia techniques, unless contraindicated.

The severity of postoperative complications occurring within the same hospitalization or within 30 days of the operative date was graded according to the Clavien-Dindo scoring system.⁷ Primary endpoints were any postoperative complication, need for secondary abdominal drainage procedures, bile leak, and 30-day readmission. Secondary drainage was defined as the placement of a peritoneal drain postoperatively by interventional radiology for percutaneous drainage of a clinically significant intra-abdominal fluid collection, biloma, or abscess. Patients did not undergo routine postoperative surveillance imaging unless clinically indicated.

Statistical analysis

Statistical Package for the Social Sciences 21.0 software (IBM, Inc) was used for all statistical analyses. Discrete categorical variables were analyzed by the chi-square test or Fisher's exact test, as appropriate. Continuous variables were assessed by the Student's *t*-test. Values are expressed as mean \pm standard deviation, unless otherwise specified. All relevant preoperative and perioperative variables were compared between the primary drain and no primary drain cohorts. Variables with a *p* value ≤ 0.05 on univariate analysis were included in the multivariate models for each endpoint, with statistical significance on multivariate analysis defined as *p* < 0.05.

RESULTS

Of 1,239 consecutive patients who underwent major hepatectomy from 2000 to 2012 across the 3 institutions, 198 patients underwent concurrent biliary reconstruction and anastomosis and were excluded, leaving 1,041 patients for analysis. Of these patients, 564 (54%) had primary intraoperative peritoneal drains placed at the surgeon's discretion. A comparison of demographics and clinicopathologic features for the cohort, stratified by primary drain placement, are summarized in [Table 1](#). Patients with primary drains demonstrated greater American Society of Anesthesiologists (ASA) class (*p* < 0.001), greater EBL (681 vs 497 mL, *p* < 0.001), and more frequent intraoperative transfusions (27.5% vs 12.4%, *p* < 0.001). Patients with primary drains also were more likely to undergo extended hepatectomy (*p* = 0.02). There were no significant differences between patients with and without primary drain placement with reference to BMI, age, presence of underlying hepatitis, preoperative lab values, or operative approach. In addition, the pathologic indication for hepatectomy and the rates of cirrhosis and steatosis on final histologic specimen were also similar between these 2 groups.

The frequencies of postoperative outcomes and complications are presented in [Table 2](#). Patients with a

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