Factors predictive of readmission after hepatic resection for hepatocellular carcinoma

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Background. *Hepatic resection is associated with substantial morbidity and resource use. To contain costs and improve outcomes, recent health care regulations focus on reducing hospital readmissions while using readmission rates as a quality measure. The goal of this investigation was to characterize the incidence, patterns, and risk factors for readmission after resection for hepatocellular carcinoma.*
Study design. *Patient demographics, operative factors, and perioperative outcomes of 245 patients undergoing hepatic resection at an academic center from 2000 to 2012 were reviewed retrospectively. Factors associated for readmission within 90 days of operation were identified through univariate and multivariate logistic regression analysis.*
Results. *Forty-six patients (18.7%) required hospital readmission. Univariate analysis identified American Society of Anesthesiologists class, preoperative Model for End-stage Liver Disease score and total bilirubin, preexisting vascular disease, acute renal failure, bile leak, peak postoperative total bilirubin, and intraabdominal infection as factors associated with readmission. Intraabdominal infection, postoperative renal failure, and a history of vascular disease were found to be significant on multivariate analysis. Overall, intraabdominal infection was the strongest predictor for readmission.*
Conclusion. *Early readmission after hepatectomy remains relatively common. Postoperative complications and patient comorbidities are the dominant factors in readmission, and we must be mindful of those patients at increased risk for readmission. (Surgery 2014;156:1039-48.)*

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Over the last several years, hospital readmissions have fallen under increasing scrutiny as a preventable source of health care costs. A 2009 article in the *New England Journal of Medicine* found that 19.6% of all hospitalized Medicare patients were readmitted within 30 days of discharge, with the 90-day readmission rate increasing to 34.0%. The annual estimated costs for these readmissions was over $17 billion.[1] For this reason, policy makers have focused on decreasing readmissions in an attempt to control costs and improve quality of care. In 2007, the Medicare Payment Advisory Commission proposed using hospital readmission rates as a quality measure, and the next year recommended that readmission rates for individual hospitals should be published.[1,2] With passage of the Affordable Care Act, the Centers for Medicare and Medicaid Services established the Hospital Readmissions Reduction Program. The program decreases payments to hospitals with excess readmission rates for acute myocardial infarction, heart failure, or pneumonia. Although the act is focused initially on common medical diagnoses, mandatory reporting of postoperative readmissions may follow in an attempt to improve surgical care and decrease costs.[2,3] This policy has raised some questions regarding the utility of using readmission rates as a quality measure after surgery, in addition to prompting reevaluation of the role that readmission plays in patient care.

Nevertheless, given this policy environment, providers have begun to identify factors that contribute to unplanned readmissions; however, little has been published evaluating risk factors for readmission after hepatic resection. A review of

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general surgery patients enrolled in the National Surgical Quality Improvement Program concluded that inpatient complications drive readmission rates, and noted a 9.7% readmission rate for hepatic surgery.[4] An analysis focusing on hepatopancreatobiliary surgery using the Surveillance, Epidemiology, and End Results database found a 14.9% readmission rate for hepatic procedures. In contrast with the National Surgical Quality Improvement Program data, however, complications were not associated with readmission. Instead, underlying patient comorbidities and duration of stay were identified as primary risk factors.[5] In a 2012 study looking specifically at hepatectomy, Barbas et al[6] found a readmission rate of 14.4% for resections that included both benign and malignant disease. On multivariate analysis, risks associated with readmission included major hepatectomy, major complications, and duration of stay >7 days. Interestingly, the indication for operation was significantly associated with readmission.[6] This finding raises the possibility that readmissions may not only depend on the specific operation performed, but could vary according to the underlying pathology or operative indication.

Most of these studies look at readmission rates within a broader context that includes mixed pathologies, and none have focused specifically on readmission after resection for hepatocellular carcinoma (HCC). Worldwide, HCC represents 85–90% of all primary liver tumors, and is the fifth most common type of cancer.[7] In the United States, HCC is one of the fastest growing causes of cancer-related mortality, and the incidence has tripled from 1.6 to 4.9 per 100,000 person per year.[8] Furthermore, HCC can be associated with underlying disease states like cirrhosis, which may put these patients at greater risk for readmission.[9] For our study, we reviewed retrospectively a series of patients who underwent operative resection for HCC to determine risk factors associated with 90-day readmission. We sought to evaluate the contribution to readmission of not only procedure-related factors, but also patient-specific factors related to the underlying diagnosis.

METHODS

We reviewed an institutional review board-approved, prospectively maintained hepatobiliary database for patients who underwent resection for HCC between November 2000 and December 2012 at the University of Louisville. All patients were ≥18 years old, underwent operation including either major or minor hepatectomy, and had proven HCC on final pathology. A retrospective chart review was performed on all patients with available medical records to extract any missing datapoints. Additional patients who underwent hepatic resection for HCC not captured within the hepatobiliary database were identified and subjected to a full retrospective chart review. Patient variables pertinent to the 90-day readmission rate were identified via literature review, including demographic information, past medical history, operative factors, and postoperative complications.

Patients who present with HCC at our institution are initially evaluated for transplantation, and those who are not transplant candidates then undergo evaluation for resection. Only patients who went on to require resection were included in this study. For patients that underwent resection, major hepatectomy was defined as a resection of ≥4 segments.[10] The presence of cirrhosis was a clinical definition that was determined by a combination of risk factors including hepatitis serology, a history of alcohol abuse, computed tomography imaging, laboratory values, and tissue diagnosis. For patients with cirrhosis, the severity was evaluated further by calculating the Model for End-stage Liver Disease (MELD) score. The presence of fibrosis in the underlying liver was based on pathology reports of resected specimens. A diagnosis of hepatitis was based on serology results, with hepatitis B defined as those with chronic infection.

Additional comorbidities were defined as outlined herein. A diagnosis of cardiac disease included a history of angina, coronary artery disease defined by cardiac catheterization, previous myocardial infarction, cardiac valve dysfunction requiring medication, a history of congestive heart failure, or a history of arrhythmias requiring medication or implanted devices. Pulmonary disease was defined as abnormal pulmonary function tests, a history of asthma or chronic obstructive pulmonary disease requiring meter-dosed inhalers, or tobacco use with a >25 pack-year history. Patients on either oral antihyperglycemic medication or those who required insulin for blood glucose control were considered diabetics. A history of vascular disease included peripheral vascular disease or aortosclerosis. Tobacco use was defined as active smokers at the time of operation, with an alcohol history consisting of previous or current alcohol abuse.

Complications within the database were recorded as described previously.[11] A biliary leak was defined as drainage of bile >50 mL after postoperative day 5, or as a bilious fluid collection