
Opportunities to Improve Care of Hepatocellular Carcinoma in Vulnerable Patient Populations



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- BACKGROUND:** Hepatocellular carcinoma (HCC) patients with Medicaid or no health insurance have inferior survival compared with privately insured patients. Safety-net hospitals that care for these patients are often criticized for their inferior outcomes. We hypothesized that HCC survival was related to appropriate surgical management.
- STUDY DESIGN:** The American College of Surgeons National Cancer Database was queried for patients diagnosed with HCC (n = 111,481) from 1998 to 2010. Hospitals were stratified according to safety-net burden, defined as the percentage of patients with Medicaid or no insurance. The highest quartile, representing safety-net hospitals, was compared with lower-burden hospitals with regard to patient demographics, cancer presentation, surgical management, and survival.
- RESULTS:** Patients at safety-net hospitals were less often white, had less income and education, but presented with similar stage HCC. Safety-net hospital patients were less likely to receive surgery (odds ratio 0.77; $p < 0.01$), and among curable patients (stages 1 and 2) who underwent surgical intervention, liver transplantation and resection were performed less often at safety-net hospitals than at other hospitals (50.7% vs 66.7%). Procedure-specific mortality rates were also higher at safety net hospitals ($p < 0.01$). However, multivariate analysis adjusting for cancer stage and type of surgery revealed similar survival for safety-net hospital patients who had surgery and survived for longer than 30 days ($p = 0.73$).
- CONCLUSIONS:** Vulnerable patients with HCC are commonly treated at safety-net hospitals, are less likely to receive curative surgery, and have worse short-term outcomes. However, safety-net patients who can endure liver surgery have a similar prognosis as patients at nonsafety-net hospitals. Providing equal access to surgery may improve survival for vulnerable populations of HCC patients. (J Am Coll Surg 2017;224:697–704. © 2017 by the American College of Surgeons. Published by Elsevier Inc. All rights reserved.)
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Hepatocellular carcinoma (HCC) is the fifth most common solid organ tumor worldwide, and is the third leading cause of cancer-related death.¹ In the US, the growing epidemic of obesity and metabolic syndrome is also projected to drive the incidence of HCC in coming years.² Recently, incidence-based mortality has decreased for these patients, potentially due to earlier detection and increases in appropriate surgical management.^{3,4} However,

there are concerns that these improvements in HCC care are not being evenly distributed across all patients. Among HCC patients, race, and insurance status are known to influence the receipt of surgery as well as long-term survival⁵⁻¹⁰; patients of minority race or with inferior health insurance receive curative surgery less often and have inferior survival compared with white, privately insured patients.

Safety-net hospitals are institutions that treat a disproportionate number of vulnerable patients, such as those with either Medicaid or no health insurance.¹¹ It has been suggested that HCC outcomes at these hospitals are influenced by advanced disease presentation, treatment delays, and underuse of curative surgery.^{12,13} Safety-net hospitals have also been shown in recent reports to have inferior short-term surgical outcomes.¹⁴⁻¹⁷ However, it is currently unclear whether long-term oncologic outcomes differ for patients treated at safety-net

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Abbreviations and Acronyms

AJCC	= American Joint Committee on Cancer
HBH	= high-burden hospital
HCC	= hepatocellular carcinoma
LBH	= low-burden hospital
MBH	= medium-burden hospital
NCDB	= National Cancer Database

hospitals compared with those treated at other centers. The aim of this study was to investigate HCC presentation, management, and short- and long-term outcomes at safety-net hospitals at a national level.

METHODS**Data source**

Data for this study were drawn from the American College of Surgeons National Cancer Database (NCDB) liver Participant User File for the years 1998 to 2011. The NCDB is a joint project of the Commission on Cancer of the American College of Surgeons and the American Cancer Society. This is a nationwide, facility-based, clinical dataset that captures 70% of all diagnosed malignancies in the US. The NCDB collects deidentified patient level data from nationally accredited cancer program registries using standardized data items and coding definitions. These data include patient demographics and detailed information regarding cancer staging, tumor histology, treatment types and courses, short-term surgical outcomes, and long-term survival. The data used in the study are derived from a deidentified NCDB file. The American College of Surgeons and the Commission on Cancer have not verified and are not responsible for the analytic or statistical methodology used, or the conclusions drawn from these data by the investigator.

Patient cohort

The liver Participant User File was queried for all patients with HCC ($n = 143,692$). Subtypes of HCC were excluded. Our analysis of patient demographics, surgical characteristics, and short-term outcomes included all of these patients. The following information was collected for all patients: age (years), sex, race (Asian, black, white, or other), primary insurance, income (median household income for patient ZIP code based on 2000 US Census data, in quartiles), education (median percentage of adults in the patient's ZIP code who did not graduate from high school based on 2000 US Census data, in quartiles), Charlson-Deyo comorbidity score (0,1,2), distance the patient traveled for treatment, American Joint Committee on Cancer (AJCC) clinical stage, facility type (academic:

>500 new cancer diagnoses annually, at least 4 postgraduate training programs; comprehensive community: >500 new cancer diagnoses annually, postgraduate training optional; community: 100 to 500 new cancer diagnoses annually, postgraduate training optional; and other).

Patients who had surgery were identified using surgical procedure codes specific to the NCDB. The following information was collected for all surgical patients: procedure type (categorized as resection, transplant, radiofrequency ablation, or other/unknown), AJCC pathologic stage, 30-day readmissions, 30-day mortality, and survival (for patients diagnosed between 1998 and 2006; median follow-up 2.5 years).

Hospital safety-net burden

Hospitals were grouped based on safety-net burden, as previously described.^{14,15} Briefly, all hospitals were assigned a safety-net burden, defined as the proportion of their patients who had Medicaid or no insurance. Hospitals were then grouped into quartiles: those in the first quartile were low burden hospitals (LBH), the middle 2 quartiles were medium burden hospitals (MBH), and those in the highest quartile were high burden hospitals (HBH), which represented the cohort of safety-net hospitals.

Statistical analysis

The race cohorts were compared with respect to the aforementioned variables using chi-square tests for categorical variables and rank-sum tests for continuous variables. Kaplan-Meier analysis was used to compare long-term survival among HCC patients based on their insurance status. Multiple logistic regression models were created to analyze predictors of having surgery; Cox regression was used to model long-term survival for patients who had surgery and did not suffer a perioperative mortality. We used a random effects model to adjust for the clustering of patients within centers. An alpha level of 0.05 was used for all significance tests. The data were analyzed using SAS 9.3 (SAS Institute).

RESULTS**Patient insurance and hepatocellular carcinoma survival**

This first step of the analysis was to investigate differences in HCC survival based on patient health insurance. Univariate survival analysis demonstrated that patients with private insurance have significantly better overall survival, whether evaluating all patients who received surgery for HCC (Fig. 1) or only early stage

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