



Facility Type is Another Factor in the Volume–Outcome Relationship for Complex Hepatopancreatobiliary Procedures

Gregory C. Wilson, MD¹, and David A. Geller, MD¹

Division of Hepatobiliary and Pancreatic Surgery, Department of Surgery, University of Pittsburgh Medical Center, Pittsburgh, PA

We would like to commend Drs. Lee, Qadan and colleagues for their recent article examining the national landscape in the management of resectable intrahepatic cholangiocarcinoma (ICC).¹ As the reader is well aware, ICC is a rare solid organ malignancy with poor long-term outcomes. Due to its rarity, the majority of historical data and study designs have grouped ICC within the category of primary liver or advanced biliary tract cancers. Unfortunately, the incidence of ICC appears to be on the rise,² likely as a result of the increased prevalence of nonalcoholic fatty liver disease (NAFLD) and nonalcoholic steatohepatitis (NASH). Surgical resection remains the cornerstone of treatment, however results remain disparaging. Anywhere from 10 to 30% of ‘potentially resectable’ patients have metastatic disease at the time of exploration.^{3,4} Adding insult to injury, recurrence after curative resection is as high as 53–68%^{5–7} and the likelihood of cure is low.⁸ Therefore, it is imperative that we as a field study every aspect of this disease process in order to optimize outcomes for this patient population.

In this current study, the authors explore outcomes after resection of ICC and the relationship of margin status and survival with facility type. It is a retrospective study utilizing the National Cancer Database (NCDB), a dataset that captures 70% of new cancer diagnoses within the US. From the 2004–2014 data files, the authors were able to identify 2256 patients undergoing hepatectomy at over 300 different facilities.¹ They provided a thorough analysis and

logical framework to support their conclusions that treatment at an academic center was associated with improved R0 resection rates, decreased 90-day mortality, and improved overall survival. Additional highlights from this article include that, overall, > 80% of patients with ICC received care at an academic center. Interestingly, the rates for utilization of an academic center were decreasing across the study time period. While R0 resections rates were higher at academic centers, a positive surgical margin rate of 21.4% (compared with 26.1% at community facilities) is still not optimal. In addition, despite the recommendation for more than six lymph nodes harvested, very few centers achieved this benchmark over the study time period, i.e. only 12.8% of academic centers and 8% of community facilities. Unfortunately, data on surgeon-specific factors, disease recurrence, and adjuvant therapy are not readily available in the NCDB and are not examined in this study.

At the heart of this study is the volume–outcome relationship and the push for regionalization of complex care, a concept that has been extensively studied in an almost frenzy-like fashion since Birkmeyer et al.⁹ published the landmark paper in the *New England Journal of Medicine* in 2002, demonstrating the relationship between hospital volume and surgical mortality. In fact, this issue of regionalization and the volume–outcome relationship dates back to much earlier in a 1979 report by Luft et al.¹⁰ identifying improved postoperative mortality for complex procedures such as open heart surgery and coronary bypass at high-volume centers. Since that time, the volume–outcome relationship has been shown to apply to high-risk cancer care,^{9,11} as well as complex hepatopancreatobiliary (HPB) procedures.^{12–14} The first volume–outcome report specifically examining liver resections was in 1998 by Choti et al.¹³ In this report, they found improved postoperative mortality

for both minor and major liver resections at high-volume centers. However, this relationship is not monogamous between only hospital volume and outcomes, with both surgeon volume^{15,16} and facility type^{17,18} each influencing patient outcomes. The authors of this current study identify facility type, rather than center volume, as a dominant variable in this complex model. Unfortunately, the exact impact of facility type and its interaction with procedural volume eludes us. In the current analysis, center volume and facility type were highly collinear variables, making it difficult to use both variables in the same model. In addition, surgeon volume and training status are unknown. In this study, facility volume was dichotomized using the median number of 11 annual hepatectomies as a cut-off between high- and low-volume centers. Unfortunately, this binary categorization eliminates some of the granularity of the data and limits the ability to better examine the exact relationship between facility type and volume. Specifically, there are few important questions that are left unaddressed. Is there a cut-off point for which low procedural volume negates the academic center status and outcomes falter? Or, conversely, is there a certain number of procedures a community center must do in order to perform at the level of an academic center?

This current study provides additional evidence supporting the push for regionalization of complex cancer care and HPB resections. The authors were able to demonstrate improved outcomes for patients with resectable ICC at academic centers, which included better R0 resection rates, reduced 90-day mortality, and improved overall survival. Intuitively, this makes sense; complex cancer care is labor-intensive and requires a strong supporting cast, including the surgical, medical, anesthetic, interventional, and endoscopic teams. However, this study also highlights some of the current shortcomings in the treatment of ICC, i.e. high number of positive margins, poor overall survival, and (although not shown here) high recurrence rates. Therefore, we believe the real message is that we still have ‘work to do’ in treating ICC and care should be concentrated at facilities with access to clinical trials and active research programs in ICC so that we not only optimize outcomes but also push the boundaries forward in the treatment of this difficult cancer. It is no surprise that this mindset is engrained in the foundation of academic facilities across the country and well represented in the NCDB.

DISCLOSURE Gregory C. Wilson and David A. Geller have no conflicts of interest to declare.

REFERENCES

1. Lee GC, Gamblin TC, Fong ZV, et al. Facility type is associated with margin status and overall survival of patients with resected intrahepatic cholangiocarcinoma. *Ann Surg Oncol*. 2019. <https://doi.org/10.1245/s10434-019-07657-5>.
2. Patel T. Increasing incidence and mortality of primary intrahepatic cholangiocarcinoma in the United States. *Hepatology*. 2001;33(6):1353–1357.
3. Goere D, Wagholikar GD, Pessaux P, et al. Utility of staging laparoscopy in subsets of biliary cancers: laparoscopy is a powerful diagnostic tool in patients with intrahepatic and gallbladder carcinoma. *Surg Endosc*. 2006;20(5):721–725.
4. D’Angelica M, Fong Y, Weber S, et al. The role of staging laparoscopy in hepatobiliary malignancy: prospective analysis of 401 cases. *Ann Surg Oncol*. 2003;10(2):183–189.
5. Hyder O, Hatzaras I, Sotiropoulos GC, et al. Recurrence after operative management of intrahepatic cholangiocarcinoma. *Surgery*. 2013;153(6):811–818.
6. Weber SM, Jarnagin WR, Klimstra D, DeMatteo RP, Fong Y, Blumgart LH. Intrahepatic cholangiocarcinoma: resectability, recurrence pattern, and outcomes. *J Am Coll Surg*. 2001;193(4):384–391.
7. Spolverato G, Kim Y, Alexandrescu S, et al. Is hepatic resection for large or multifocal intrahepatic cholangiocarcinoma justified? Results from a multi-institutional collaboration. *Ann Surg Oncol*. 2015;22(7):2218–2225.
8. Spolverato G, Vitale A, Cucchetti A, et al. Can hepatic resection provide a long-term cure for patients with intrahepatic cholangiocarcinoma? *Cancer*. 2015;121(22):3998–4006.
9. Birkmeyer JD, Siewers AE, Finlayson EV, et al. Hospital volume and surgical mortality in the United States. *N Engl J Med*. 2002;346(15):1128–1137.
10. Luft HS, Bunker JP, Enthoven AC. Should operations be regionalized? The empirical relation between surgical volume and mortality. *N Engl J Med*. 1979;301(25):1364–1369.
11. Birkmeyer JD, Sun Y, Goldfaden A, Birkmeyer NJ, Stukel TA. Volume and process of care in high-risk cancer surgery. *Cancer*. 2006;106(11):2476–2481.
12. Fong Y, Gonen M, Rubin D, Radzyner M, Brennan MF. Long-term survival is superior after resection for cancer in high-volume centers. *Ann Surg*. 2005;242(4):540–544; **discussion 544–547**.
13. Choti MA, Bowman HM, Pitt HA, et al. Should hepatic resections be performed at high-volume referral centers? *J Gastrointest Surg*. 1998;2(1):11–20.
14. Dimick JB, Cowan JA Jr, Knol JA, Upchurch GR Jr. Hepatic resection in the United States: indications, outcomes, and hospital procedural volumes from a nationally representative database. *Arch Surg*. 2003;138(2):185–191.
15. Birkmeyer JD, Stukel TA, Siewers AE, Goodney PP, Wennberg DE, Lucas FL. Surgeon volume and operative mortality in the United States. *N Engl J Med*. 2003;349(22):2117–2127.
16. Eppsteiner RW, Csikesz NG, Simons JP, Tseng JF, Shah SA. High volume and outcome after liver resection: surgeon or center? *J Gastrointest*. 2008;12(10):1709–1716; **discussion 1716**.
17. Dimick JB, Cowan JA Jr, Colletti LM, Upchurch GR Jr. Hospital teaching status and outcomes of complex surgical procedures in the United States. *Arch Surg*. 2004;139(2):137–141.
18. Hyder O, Sachs T, Ejaz A, Spolverato G, Pawlik TM. Impact of hospital teaching status on length of stay and mortality among patients undergoing complex hepatopancreaticobiliary surgery in the USA. *J Gastrointest Surg*. 2013;17(12):2114–2122.

Publisher’s Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.