Minimally Invasive Hepatectomy: Trends and Opportunities for Improvement

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Abstract

Introduction: We aimed to examine national trends in minimally invasive (MIH) versus open (OH) hepatectomy and identify opportunities for improvement.

Methods: 25,393 partial, left, right, and extended hepatectomies were identified from 2014-2019 in the participant use file of the American College of Surgeons National Surgical Quality Improvement Program with hepatectomy targeted procedure variables. The distribution of hepatectomies performed over years was examined, with particular focus on approach (open/laparoscopic/robotic), indication (benign/malignant), type of resection (minor versus major hepatectomy, defined as any hemi or extended hepatectomy), and risk-adjusted 30-day outcomes. Independent predictors of receipt of MIH were identified by multivariable logistic regression.

Results: The number of hepatectomies being captured has increased every year from 2014 to 2019. The proportion of MIH (laparoscopic/robotic) increased from 24% in 2014 to 29% in 2017 then plateaued to 28% from 2018-2019 (P<0.001). Laparoscopic approach increased from 22% in 2014 to 26% in 2017 then decreased to 23% in 2019 whereas robotic approach increased from 1.6% in 2014 and steadily increased every year to 4.3% in 2019 (P<0.001). Most MIH is performed for benign (60%) versus malignant (40%) indications (P<0.001). In patients who underwent MIH for malignant conditions, 86% were for tumors <5 cm and 14% were for tumors >5 cm or with major vascular invasion (P<0.001). There were more minor (84%) versus major (16%) MIH (P<0.001). Independent predictors of MIH include: minor hepatectomy (OR=3.12, P<0.001), age ≥80 years old (OR=1.18, P=0.004), operative year (2017 OR=1.23, P<0.001; 2018 OR=1.14, P=0.019; 2019 OR=1.13, P=0.028), and benign diagnosis (OR=2.21, P<0.001). MIH compared to OH was associated with improved postoperative 30-day composite outcome on multivariable analysis encompassing reoperative interventions including percutaneous/endoscopic procedures, any end organ failure including Grade B/C liver failure, or death (OR=0.61, P<0.001).

Discussion: MIH has increased since 2014 with plateau from 2017-2019. There has been increased use of robotic with subsequent decrease in laparoscopic approach, suggesting the robotic platform has not substantially increased adoption of MIH. Despite increased use of MIH, most of the cases are minor hepatectomies, typically for benign disease, and tumors <5 cm if there is a malignant indication. As oncologic patients may derive the most benefit from MIH with respect to improved perioperative outcomes and thus enhanced recovery for receipt of adjuvant therapies, increased focus on expanding MIH for malignant indications, major hepatectomies, and larger tumors should be considered.

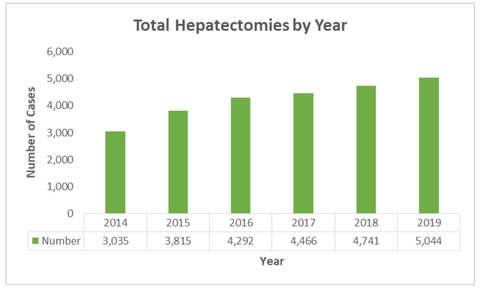
Introduction

- Operative blood loss and duration of hospital stay are significantly reduced with laparoscopic liver resection without increased morbidity or mortality, compared to open hepatic resection.
- Approach to minimally invasive hepatectomy (MIH) have been compared and are essentially equivalent with respect to outcomes (laparoscopic or robotic).
- We aimed to look at trends in MIH and opportunities for improvement in the US.

Methods

- The 2014-2019 ACS NSQIP participant use file was reviewed for hepatectomies for all indications. Inclusion criteria consisted of patients undergoing CPT codes: 47120 (partial lobectomy), 47122 (trisectionectomy), 47125 (left hepatectomy), 47130 (right hepatectomy). The main NSQIP PUF was then merged with the Target Hepatectomy PUF for additional hepatectomy specific variables for a total of 25,393 cases.
- The distribution of hepatectomies performed over years was examined with particular focus on approach, indication, and type of resection. Independent predictors of MIH were identified.

Results



Results

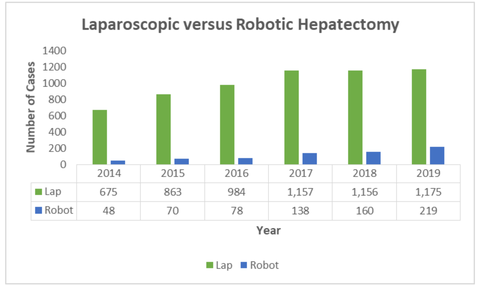
Variable	Odds Ratio	95% Confidence Interval	P-Value
Partial Hepatectomy (not formal lobectomy or trisectionectomy)	3.00	2.79-3.23	<0.001
Age			
≤ 40 years	Referent	Referent	Referent
41-50 years	1.05	0.93-1.18	0.441
51-60 years	1.03	0.93-1.15	0.575
61-70 years	1.09	0.98-1.21	0.112
≥ 80 years	1.19	1.06-1.33	0.003
Female Sex	1.07	1.00-1.14	0.037
Race			
White	Referent	Referent	Referent
Black	1.13	1.01-1.25	0.029
Asian	1.53	1.37-1.72	<0.001
Other / Unknown	1.08	1.01-1.17	0.032
Body Mass Index			
≤ 24.9 Kg / m^2	Referent	Referent	Referent
25-29.9 Kg / m^2	0.97	0.83-1.12	0.659
30-34.9 Kg / m^2	1.01	0.87-1.16	0.936
35-39.9 Kg / m^2	1.01	0.87-1.18	0.886
≥ 40 Kg / m^2	1.10	0.94-1.29	0.212
Operative Year			
2014	Referent	Referent	Referent
2015	0.97	0.86-1.09	0.622
2016	0.98	0.88-1.10	0.748
2017	1.24	1.11-1.38	<0.001
2018	1.14	1.02-1.27	0.019
2019	1.12	1.01-1.25	0.035
Benign Diagnosis	2.04	1.90-2.20	<0.001
Tumor Size ≤ 5cm (for Malignant Diagnosis)	1.67	1.51-1.85	<0.001

Table 1 (above): Multivariable logistic regression for identification of predictors of MIH.

Figure 1 (left): Trends in Hepatic Resections by Year (P<0.001).

Figure 2 (right): Trends in MIH by Year (P<0.001).

Results



Discussion

- MIH has increased since 2014 with a plateau from 2017-2019.
- There has been increased use of robotic with subsequent decrease in laparoscopic approach, suggesting the robotic platform has not substantially increased adoption of MIH.
- Despite increased use of MIH, most MIH cases are minor hepatectomies, typically for benign indications.
- In patients who undergo MIH for malignant conditions, tumors are predominantly small in size (≤ 5 cm).

SAGES 2022 Abstract ID: 118458