Background

• The International Study Group of Livery Surgery’s (ISGLS) criteria defines and grades PHLF severity to predict patient prognosis: A (mild), B (moderate), and C (severe)
• Grade A PHLF represents abnormal laboratory parameters of liver function that requires no change in the clinical management of the patient
• It is unclear if outcomes for grade A patients differ in the short term post-operative period than non-failure patients
• A closer look at the clinical relevance of grade A patients is warranted

Research Objectives

1) Identify risk factors associated with grade A PHLF
2) Assess morbidity and mortality of major hepatectomy patients with and without PHLF

Methods

• Data obtained from the ACS NSQIP hepatocemy–targeted dataset from 2014 to 2018
• Included patients undergoing an elective major hepatectomy identified by CPT codes 47122, 47125, 47130.
• Bivariate analysis was used to compare patient and operative characteristics against PHLF grades using Chi-square tests
• Multivariable logistic regression was used to evaluate the association between PHLF grade and outcomes

Results

• Total study population n = 6274, Total PHLF=9.6%
• Incidence of PHLF grade A 4.3% and grades B/C 5.3%
• Overall, PHLF was associated with increased hospital length of stay, overall mortality, serum morbidity, need for postoperative interventions, and mortality
• Patients with grade A had similar odds of mortality compared to patients without PHLF but had significantly worst odds of morbidity (NSQIP composite scores, length of stay, readmission, post-op invasive interventions and reoperations).

Limitations

• Analysis restricted to outcomes within 30 days of the post-operative period
• Could not measure pre and post-operative liver volumes and did not address affect of concurrent liver resections

Conclusions

• With the exception of mortality, grade A PHLF had worse outcomes than patients without PHLF.
• The ISGLS criteria correlates with clinical outcomes (overall and serious morbidity, length of stay, readmission, post-operative interventions, and mortality)
• Acknowledging the risks associated with grade A PHLF will allow surgeons and patients to anticipate complications and management.

Table 1. Patient Characteristics by PHLF Grade

<table>
<thead>
<tr>
<th>ASA Classification (%)</th>
<th>None (n=5672)</th>
<th>Grade A (n=271)</th>
<th>Grade B/C (n=331)</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 and 2</td>
<td>1574 (27.8)</td>
<td>76 (28)</td>
<td>55 (16.6)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>3 and 4</td>
<td>4096 (72.3)</td>
<td>195 (72)</td>
<td>276 (83.4)</td>
<td></td>
</tr>
</tbody>
</table>

Gender (%):

- Female 2871 (50.6) 92 (34) 131 (38.6) <0.001
- Male 2084 (49.4) 179 (66.1) 200 (60.4)        

Age (%):

- <55 2003 (35.7) 90 (33.2) 77 (23.3) <0.001
- 55-64 1960 (27.6) 66 (24.4) 83 (25.1)        
- >65 2089 (38.6) 155 (42.4) 171 (51.7)        

Race (%):

- White 3394 (59.5) 134 (49.6) 192 (58.6) <0.001
- Black 436 (7.7) 19 (7.1) 17 (5.1)        
- Hispanic 270 (4.8) 10 (3.7) 11 (3.3)        
- Other 1572 (27.2) 108 (39.9) 111 (33.5) <0.001
- **Pre-op discriminant**
  - +1 or unknown 2191 (51.5) 248 (91.5) 27 (8.9) <0.001
  - >1 481 (8.5) 23 (8.3) 60 (18.1)        

Pathology (%):

- Benign 952 (16.8) 19 (7) 21 (6.3) <0.001
- Primary 1909 (33.7) 119 (43.9) 186 (56.2)
- Secondary or unknown 2811 (49.6) 133 (49.1) 124 (37.5)

Liver texture (%):

- Abnormal 1365 (22.3) 78 (28.2) 103 (31.1) <0.001
- Normal or Unknown 4407 (77.7) 192 (73.8) 228 (68.9)

Extent of resection (%):

- Total Left 1660 (29.3) 27 (10) 27 (8.2) <0.001
- Right 2701 (47.7) 176 (64.9) 178 (54.8)

Trisegmentectomy:

- No 9020 (88.6) 204 (62.7) 217 (65.6) <0.001
- Yes 952 (11.5) 47 (13.3) 114 (34.4)

Concurrent Colorectal Procedure (%):

- Yes 199 (3.5) 16 (9.1) 19 (5.7) 0.018
- No 5473 (96.5) 255 (94.1) 312 (94.3)

Table 2. Incidence of Post-Operative Outcomes by PHLF Grade

<table>
<thead>
<tr>
<th>none</th>
<th>Grade A (n=271)</th>
<th>Grade B/C (n=331)</th>
<th>30 day Mortality (%)</th>
<th>Adjusted Odds Ratios</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>2503 (98.8)</td>
<td>268 (99.9)</td>
<td>247 (74.8)</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>69 (12)</td>
<td>11 (3.7)</td>
<td>84 (25.4)</td>
<td></td>
</tr>
</tbody>
</table>

Serious Morbidity Grade A:

- None | 4117 (87.1)    | 161 (99.4)       | 85 (25.7)            |                     |
- Yes  | 1050 (18.8)    | 110 (40.8)       | 246 (74.3)           |                     |

Overall Mortality Grade A:

- None | 6577 (90.7)    | 158 (58.3)       | 90 (27.2)            |                     |
- Yes  | 1523 (103)     | 112 (41)         | 241 (81.5)           |                     |

Length of stay Grade A:

- None | 2442 (26.7)    | 79 (29.2)        | 45 (13.8)            |                     |
- Yes  | 2230 (39.3)    | 156 (57.9)       | 298 (88.4)           |                     |

Readmission Grade A:

- None | 2015 (38.4)    | 214 (79)         | 263 (79.5)           |                     |
- Yes  | 697 (11.6)     | 57 (21)          | 88 (25.9)            |                     |

Unplanned Readmission Grade A:

- None | 3946 (98.9)    | 242 (89.3)       | 259 (78.3)           |                     |
- Yes  | 176 (3.1)      | 29 (10.7)        | 72 (21.8)            |                     |

Figure 1. Adjusted Odds-Ratios of Outcomes by PHLF Grade

<table>
<thead>
<tr>
<th>Outcome</th>
<th>None</th>
<th>Grade A</th>
<th>Grade B/C</th>
<th>30 day Mortality (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Readmission</td>
<td>2.9 (1.5, 5.3)</td>
<td>5.9 (3.3, 8.3)</td>
<td>2.6 (1.8, 3.4)</td>
<td></td>
</tr>
<tr>
<td>Readmission Grade A</td>
<td>2.9 (1.5, 5.3)</td>
<td>5.9 (3.3, 8.3)</td>
<td>2.6 (1.8, 3.4)</td>
<td></td>
</tr>
<tr>
<td>Readmission Grade B/C</td>
<td>2.9 (1.5, 5.3)</td>
<td>5.9 (3.3, 8.3)</td>
<td>2.6 (1.8, 3.4)</td>
<td></td>
</tr>
</tbody>
</table>

*Overall mortality and Severe morbidity are ACS-NSQIP composite scores that include complications such as surgical site infections, renal failure, sepsis, unplanned intubations, and more. 2Length of Stay in the fourth quarter. 3Non-operative interventions include any invasive procedures (i.e. ERCP)

Disclosures

Dr. Bona Ko was supported by the Agency for Healthcare Research and Quality in partial stipend support under Award Number F32HS027724. Dr. David Bentrem is the Chair of the ACS NSQIP HPB Collaborative for 2020-2021. The authors have no other disclosures or conflicting interests.