

## Applying the IWATE Criteria to Robotic Hepatectomy: Is there a “Robotic Effect?”

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**Background:** The index-based IWATE criteria is a validated scoring system for the difficulty of a laparoscopic liver hepatectomy. The IWATE criteria show worsening ‘in-hospital outcomes’ with increasing difficulty levels. The objective of this study is to apply this criteria to our robotic experience.

**Methods:** With IRB approval, we prospectively followed 105 patients undergoing robotic hepatectomy from 2013 to 2019. Utilizing the index-based IWATE criteria, a 4-level classification system involving 6 preoperative factors, operations were categorized into Low (0-3), Intermediate (4-6), Advanced (7-9), and Expert (10-12). These factors include tumor location (1-5), size (0-1), proximity to major vessel (0-1), extent of liver resection (0-4), HALS/Hybrid (-1-0), and liver function (0-1). The difficulty level was determined by the sum of these preoperative factors. For illustrative purposes, data are presented as median (mean±SD).

**Results:** Overall, patients who underwent robotic hepatectomy had an age of 62 (61±13.1) years, BMI of 28 (29±6.1) kg/m<sup>2</sup>, with 38% being women. ASA class was 3 (3±0.6). Operative duration was 226 (240±80.5) minutes and estimated blood loss (EBL) was 150 (261±319.0) mL. One patient had an intraoperative complication and the operation was converted to ‘open’. 14 patients required ICU admission, with a duration of 2 (4±5.1) days. 10 patients had postoperative complications with one in-hospital mortality, due to respiratory failure. Length of stay (LOS) was 3 (5±3.9) days. 15 patients were readmitted within 30 days with one death after readmission, due to cardiac arrest.

Of the 105 operations, 2 were categorized as Low, 31 as Intermediate, 49 as Advanced, and 23 as Expert. When comparing all three difficulty levels together, excluding Low, demographic data, conversions, intraoperative complications, and postoperative outcomes were the same. EBL and operative duration were found to be significantly greater as you increased the difficulty level ( $p=0.0277$  and  $p<0.0001$ , respectively).

To investigate this further, each difficulty level was individually compared. Intraoperatively, when comparing Expert and Intermediate, EBL and operative duration were significantly greater ( $p=0.0001$  and  $p=0.0031$ , respectively). In the comparison of Expert with Advanced, operative duration was significantly longer ( $p=0.0001$ ). In the comparison of Advanced with Intermediate, there were no significant differences.

Postoperatively, comparisons between Expert and Intermediate, Expert and Advanced, and Advanced and Intermediate showed no differences. In these three distinct comparisons, requiring ICU admittance, ICU duration, complications, in-hospital mortality, LOS, readmission within 30 days, and death within 30 days were all the same.

**Conclusion:** As expected, EBL and operative duration increased with higher difficulty index in patients undergoing robotic hepatectomy. However, with the robotic approach, our postoperative outcomes were similar irrespective of difficulty levels. Perhaps, by offering a platform to undertake Expert level hepatectomy, the robotic approach potentially has a mitigating effect on postoperative outcomes regardless of difficulty level.

	Low	Intermediate	Advanced	Expert	Total
Patients, n	2	31	49	23	105
Women, n (%)	2 (100)	12 (39)	18 (37)	10 (43)	42 (40)
Age, y, median (mean ± SD)	59 (59 ± 1.4)	61 (61 ± 13.2)	63 (62 ± 13.8)	63 (60 ± 12.7)	62 (61 ± 13.1)
BMI, kg/m2, median (mean ± SD)	25 (25 ± 6.2)	28 (28 ± 6.4)	28 (28 ± 5.0)	30 (30 ± 7.8)	28 (29 ± 6.1)
ASA class, median (mean ± SD)	3 (3 ± 1.4)	3 (3 ± 0.6)	3 (3 ± 0.6)	3 (2.7 ± 0.56)	3 (3 ± 0.6)
Operative duration, min, median (mean ± SD)	180 (180 ± 0.7)	196 (205 ± 58.8) *	217 (229 ± 78.5) *	309 (314 ± 69.3)	226 (240 ± 80.5)
Estimated blood loss, mL, median (mean ± SD)	65 (65 ± 49.5)	100 (151 ± 216.8) *	150 (282 ± 353.7)	300 (381 ± 327.4)	150 (261 ± 319.0)
Conversion to Open, n/N (%)	0/2 (0)	0/31 (0)	0/49 (0)	1/23 (4)	1/105 (1)
Intraoperative Complications, n/N (%)	0/2 (0)	0/31 (0)	0/49 (0)	1/23 (4)	1/105 (1)
Admitted to ICU, n/N (%)	0/2 (0)	2/31 (6)	10/49 (20)	2/23 (9)	14/105 (13)
ICU Duration, d, median (mean ± SD)	0 (0 ± 0.0)	2 (2 ± 0.7)	3 (5 ± 5.8)	2 (2 ± 1.4)	2 (4 ± 5.1)
Postoperative Complications, n/N (%)	0/2 (0)	4/31 (13)	6/49 (12)	0/23 (0)	10/105 (10)
In-Hospital Mortality, n/N (%)	0/2 (0)	0/31 (0)	1/49 (2)	0/23 (0)	1/105 (1)
Length of stay, d, median (mean ± SD)	2 (2 ± 1.4)	3 (4 ± 3.3)	3 (5 ± 4.9)	4 (4 ± 1.7)	3 (5 ± 3.9)
Readmission Within 30 Days, n/N (%)	0/2 (0)	5/31 (16)	7/49 (14)	3/23 (13)	15/105 (14)
Death Within 30 Days, n/N (%)	0/2 (0)	1/31 (3)	1/49 (2)	0/23 (0)	2/105 (2)

\* < Expert, p < 0.05

