

1 **Abstract**

2 **Background:** Drainage exceeding 50% of total liver volume is a beneficial prognostic
3 factor in patients with unresectable malignant hilar biliary obstruction (UMHBO).
4 However, it is unclear what threshold percentage of total liver volume drained ("liver
5 drainage rate") significantly improves survival in patients with UMHBO patients who
6 received systemic chemotherapy.

7 **Objectives:** We aimed to assess optimal liver drainage rate that improves survival in
8 patients with UMHBO receiving chemotherapy using a three-dimensional (3D)-image
9 volume analyzer.

10 **Design:** This study was a single-center retrospective cohort study.

11 **Methods:** Data of 90 patients with UMHBO who received chemotherapy after
12 endoscopic biliary drainage using metal stents at Okayama University Hospital from
13 January 2003 to December 2020 were reviewed. The liver drainage rate was calculated
14 by dividing the drained liver volume by the total liver volume using a 3D-image volume
15 analyzer. The primary endpoint was overall survival by liver drainage rate. The
16 secondary endpoints were time to recurrent biliary obstruction (TRBO) and prognostic
17 factors.

18 **Results:** The median total liver volume was 1172 (range: 673–2032) mL, and the

19 median liver drainage rate was 83% (range: 50–100). Overall survival was 376 (95%CI:
20 271–450) days, and patients with >80% drainage (n=67) had significantly longer
21 survival than those with <80% drainage (n=23) (450 versus 224 days, $P = .0033$, log-
22 rank). TRBO was 201 (95%CI: 155–327) days and did not differ significantly by liver
23 drainage rate. Multivariate Cox proportional hazards regression analysis revealed >80%
24 liver drainage (HR: 0.35, 95%CI: 0.20–0.62, $P = .0003$) and hilar cholangiocarcinoma
25 (HR: 0.30, 95% CI: 0.17–0.50, $P < .0001$) as significant prognostic factors.

26 **Conclusions:** In patients with UMHBO scheduled for chemotherapy, >80% drainage is
27 associated with improved survival. Further prospective multicenter studies are needed to
28 verify the results of this study.

29 **Registration:** Okayama University Hospital, IRB number: 2108-011

30 **Keywords:** biliary obstruction, chemotherapy, CT volumetry, endoscopic biliary
31 drainage, self-expandable metal stent

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