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Letter to the editor

Can fluorescence imaging evaluate precise anatomic liver resection accurately?

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Abbreviations

ALR: anatomic liver resection

ICG: indocyanine green

MIPS: Medical Imaging Projection System

Dear editor,

We read with great interest the paper by Nishino et al., “What is a precise anatomic resection of the liver? Proposal of a new evaluation method in the era of fluorescence navigation surgery” (1). The authors reported that real-time navigation using the Medical Imaging Projection System (MIPS) improved the accuracy of anatomic liver resection (ALR) along the intersegmental/sectional planes based on the results of their new evaluation formula. We appreciate the authors’ efforts to improve the precision of hepatectomy using the original method. However, we would like to point out several concerns.

Many surgeons have already reported that intersegmental/sectional planes are visualized not only on the liver surfaces but also on the raw surfaces during liver transection using indocyanine green (ICG) fluorescence imaging (2). However, the intrinsic characteristics of ICG should be considered when ICG fluorescence imaging is used in liver surgery. It absorbs near-infrared light at approximately 760 nm and emits fluorescence at approximately 860 nm. Light of this specific wavelength can easily penetrate the tissue up to a depth of 10 mm. This feature of ICG fluorescence blurs the border between perfused and non-perfused areas on a fluorescence image. Slight fluorescence in the transection zone can either be regarded as a perfused or ischemic area. Thus, it is controversial to determine whether the boundary between fluorescence and non-fluorescence regions is a true intersegmental/sectional plane (3,4). We speculated that the low fluorescence area ratio of the remnant side with 23.5% in Figure 4 (theoretically should be 100%) arose from this intrinsic inaccuracy in ICG fluorescence imaging despite the use of MIPS. This feature of ICG also produces a false-positive result for the cut surface of the liver. Even if the transection plane is

shifted 5 mm to the ischemic region (resected side, non-perfused region), ICG fluorescence might be visualized on the cut surface of the remnant side due to fluorescence penetration. This may affect the accurate fluorescence area ratio of the case with the resection line shifted to the right (non-fluorescence region). It should be 0 %, but it might show a higher ratio due to fluorescence penetration.

In addition, the densitometry of ICG fluorescence images, which evaluates the fluorescence areas on the transection planes, is also problematic, because the accurate fluorescence ratios are greatly dependent on the adjustment of the threshold of the fluorescence intensity. Moreover, the authors used MIPS for liver resection, but they used different fluorescence modalities to evaluate the accuracy of ALR. The relationship between the strength of fluorescence and blood perfusion status should be elucidated for each imaging modality.

We emphasize that evaluating the accuracy of ALR is quite important because an objective quantitative evaluation method is limited and a clinically relevant evaluation has not been performed. Thus, the authors' method would be the first step in evaluating the accuracy of ALR, regardless of several limitations. We hope that a novel quantitative imaging technology without false-positive results will emerge for precise ALR.

Conflict of Interest: The authors declare no conflicts of interest.

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