PRECISION SURGERY FOR MELANOMA LIVER METASTASIS: THE ROLE OF ICG-NIRF IMAGING IN R0 MARGIN VALIDATION

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Introduction

This case report serves as the starting point for a pilot study focused on adapting the NIRF imaging technique for assessing tumor margins in patients with melanoma liver metastasis or other non-CRLM undergoing laparoscopic resection.

This is our first melanoma liver metastasis resection, and we obtained an R0 margin status. Minimally-invasive resection using ICG-fluorescence was performed (Fig 2), and NIRF images were acquired during surgery from both the resection specimen and the wound bed. Videolaparoscopy was performed with Image1 S Rubina from Storz ™ that obtains 4K images for fluorescence guided images with overlay mode.

We hypothesized that a protruding fluorescent rim at the parenchymal side of the resection specimen might indicate tumor proximity and predict a tumor-positive surgical margin. The acquired NIRF images were then correlated with the final histopathological assessment of the resection margin.



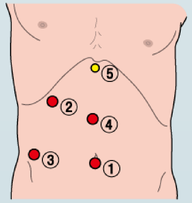


Fig 1. CT. Melanoma Metastases segment VI

Methodology

Achieving complete tumor removal (R0 resection) is crucial for long-term survival in patients with liver cancer or liver metastases. However, current intraoperative imaging techniques lack the sensitivity and real-time capabilities to reliably determine R0 resection margins. Similar to colorectal liver metastases (CRLM), resections in melanoma patients often result in tumor-margin positivity, highlighting the need for improved visualization during surgical techniques.

Near-infrared fluorescent (NIRF) imaging, utilizing the contrast agent indocyanine green (ICG), has shown promise in various surgical applications. Notably, low-dose ICG administration (10 mg), 48 to 24 hours prior to surgery, allows its accumulation in hepatocytes surrounding melanoma liver metastases, generating a distinctive fluorescent 'rim' around the lesions, particularly those located at the liver periphery. Real-time guidance through NIRF imaging enables surgeons to attain margin-negative resections (>1 mm) by excising the metastasis along with the entire surrounding fluorescent rim.

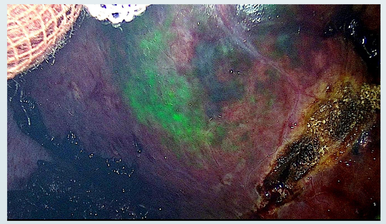


Fig 2 ICG NIRF image segment VI

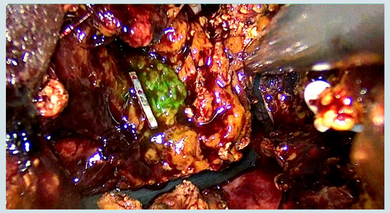


Fig 3 ICG NIRF image surgical margin

Results

In our experience with non-colorectal liver metastasis, all lesions with a positive NIRF resection plane were confirmed to have tumor-positive margins.

In this melanoma case, after an US laparoscopic examination, we found an in vivo lesion with a protruding rim in the wound bed (Fig 3). We extended the wound bed to an area without fluorescence.

The surgical specimen was diagnosed with tumor-negative margins.

The study outlines a surgical workflow to document the NIRF signal, laying the groundwork for future clinical studies evaluating the resection margin in vivo.

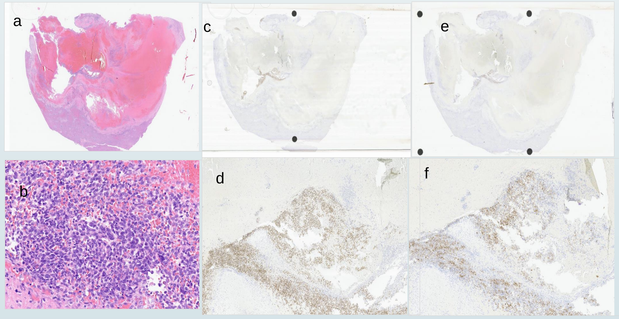


Fig 4 a,b) Histopathological findings demonstrated diffuse proliferation of atypical cells with prominent nuclei of varying size accompanied by melanin deposition. Cells with evident and dense cytoplasm
c,d) HMB 45 positive.
e,f) Sox 10 positive

Conclusions

Validation of R0 margins during laparoscopic resection of melanoma liver metastasis using NIRF imaging and ICG represents a promising frontier in surgical oncology.

This case report confirms the feasibility, reliability, and potential clinical impact of this innovative approach, providing a crucial step toward optimizing outcomes in non-colorectal liver metastasis resections.

As the field continues to evolve, the validation of R0 margins through NIRF imaging could become a standard practice, ushering in a new era of precision surgery for melanoma liver metastasis

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