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Accepted Article

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Challenges in the interpretation of colorectal indocyanine green fluorescence angiography: Video Vignette

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Accepted Article

Jeffrey Dalli[1,2], Niall Hardy[1,2], Pol G Mac Aonghusa[3], Jonathan P Epperlein[3], Padraig Cantillon Murphy[4,5], Ronan A Cahill[1,2]

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Colorectal anastomotic leakage remains a serious complication with implications on hospital stay, oncological outcomes(1) and treatment cost. (2) Traditional intra-operative visual perfusion assessment has been shown to be suboptimal(3) and surgeons are looking to indocyanine green (ICG) fluorescence angiography as an adjunct to clinical judgement. A significant body of work demonstrated feasibility of use(4),(5) and a recent randomised trial showed positive results,(6) however not all studies have found similarly.(7) Although clinical trials are ongoing, signal sensing and presentation have not been standardised. Inter-brand variation in image stack and camera performance are further confounded by distance and ICG concentration effects.(8) Even when using the same equipment, inter-user variability especially among inexpert users has been demonstrated.(9)

In the following video, we describe ICG 'creep' as different portions of the bowel achieve peak intensity over a time continuum. Delaying interrogation and interpretation for example while positioning the stapler, may result in perceived margin migration. This phenomenon is already accounted for in some upper gastro-intestinal surgery recommendations, that adequate perfusion is to be discriminated at ninety seconds.(10)

Secondly, we use temporal-fluorescence signal profiles to direct attention to the timing of these peaks and troughs. (11),(12) Using a bespoke tracker, (13) signal profile interrogation revealed lower absolute intensities at the periphery of the image despite well perfused inflows. Operators are thus prone to overestimate central image perfusion.

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Such human inter-user interpretation inconsistencies may result in suboptimal capitalisation of fluorescence angiography. While manufactures emphasise intensity via hybridised images with glowing colours, accurate quantitative fluorescence signal appreciation may in fact only be reliably achieved via computer vision.

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What does this paper add to the existing literature?

This video publication illustrates some of the difficulties in the visual interpretation of the fluorescence angiogram in colorectal surgery anastomosis. Surgical users should be aware of these pitfalls however better interpretation may require decision support in the form of artificial intelligence.

Ethics and Patient Statement: Research was carried out in accordance with relevant guidelines, regulations and with institutional (Mater Misericordiae University Hospital, Dublin, Ireland) ethics approval (1/378/2092, ClinicalTrials.gov Identifier: NCT04220242) Informed consent was obtained from all participants.

Author contributions: All the authors contributed to the design, implementation of the research, analysis of the results and to the writing of the manuscript.

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