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PROBE TIP CONTACT FORCE AND BOWEL DISTENSION AFFECT CRYPT MORPHOLOGY DURING CONFOCAL ENDOMICROSCOPY

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Introduction Endoscopic probe-based confocal endomicroscopy (pCLE) provides 500 µm diameter *en-face*, cellular resolution, 'optical biopsies' of the gastrointestinal mucosal surface. Many burgeoning classification criteria incorporate crypt morphology analysis: hyperplastic colonic polyps display 'star-shaped' crypt openings; ulcerative colitis features enlarged crypt openings with increased intercryptal separation.¹ We hypothesised that pCLE probe tip contact force and bowel distension may affect crypt morphology independently.

Methods For the *ex-vivo* force study, still pCLE images were acquired of 3 × 3 cm pieces of porcine colon applied with topical 0.02% acriflavine. A rig vertically suspended the bowel against a compressible surface. A 2.5 mm diameter pCLE probe, clamped to a force-sensitive linear servo mechanism was driven perpendicularly into fresh tissue regions until a contact force of 0.005, 0.05, 0.1, or 0.5 N was achieved. 20 images were analysed for each force.

For the *in vivo* bowel distension study, in an anaesthetised 70 kg pig using intravenous fluorescein 10%, 20 representative stills were analysed from each of 2-min endoscopic pCLE video loops with gentle probe contact against sigmoid (A) collapsed, (B) inflated to 4 cm diameter and (C) hyperinflated to 6 cm diameter using a proximal bowel clamp.

Results In the *ex vivo* study, as the probe contact force increased, the crypts appeared to be squeezed out of the field of view, and the mean visible crypt number per image decreased: 16.8 (±3.1) at 0.005N, 9.5 (±1.4) at 0.05N, 8.3 (±1.4) at 0.1N and 5.7 (±1.4) at 0.5N. Furthermore, the mean crypt diameter increased according to contact force: 46 µm (±11) at 0.005N, 61 µm (±18) at 0.05N, 74 µm (±16) at 0.1N and 89 µm (±27) at

0.5N. In the sigmoidoscopy study, for collapsed, inflated and hyperinflated sigmoid colon respectively, the mean number of visible crypts decreased: 23.7 (± 3.1), 14.0 (± 2.1) and 8.1 (± 0.7). Similarly, the mean crypt diameter increased: 65.4 μm (± 2.2), 85 μm (± 2.1) and 95.6 μm (± 2.8).

Conclusion Both increasing pCLE probe tip contact force and bowel distension reduce the number of visible crypts per field of view, and increase the mean crypt diameter. This may have important implications for standardising image acquisition protocol during endoscopic pCLE to ensure morphological alterations to crypts can be exclusively attributed to tissue differences.

Competing interests None.

Keywords confocal endomicroscopy, endoscopy.

REFERENCE

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