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Background/Aim

Creating and maintaining an adequate submucosal lift are critical steps in endoscopic submucosal dissection (ESD), directly impacting procedural efficiency, en bloc resection rates, and the risk of perforation or deep mural injury¹. Traditionally, a submucosal lift is established using a sclerotherapy catheter (SC) with needle injection. Modern needle knives (NK) incorporate a low-pressure injection (LPI) channel that allows an endoscopist to augment their lift via direct syringe injection into the exposed submucosa during dissection. An alternative NK platform utilizes foot pedal controlled high-pressure punctureless injection (HPPI) to generate and maintain submucosal elevation through intact mucosa, eliminating the need for an SC and potentially reducing instrument exchanges². This ex vivo calf large bowel ESD study compared the two types of NK's regarding procedural efficiency, quality, and safety. The preliminary results are presented.



Figures:

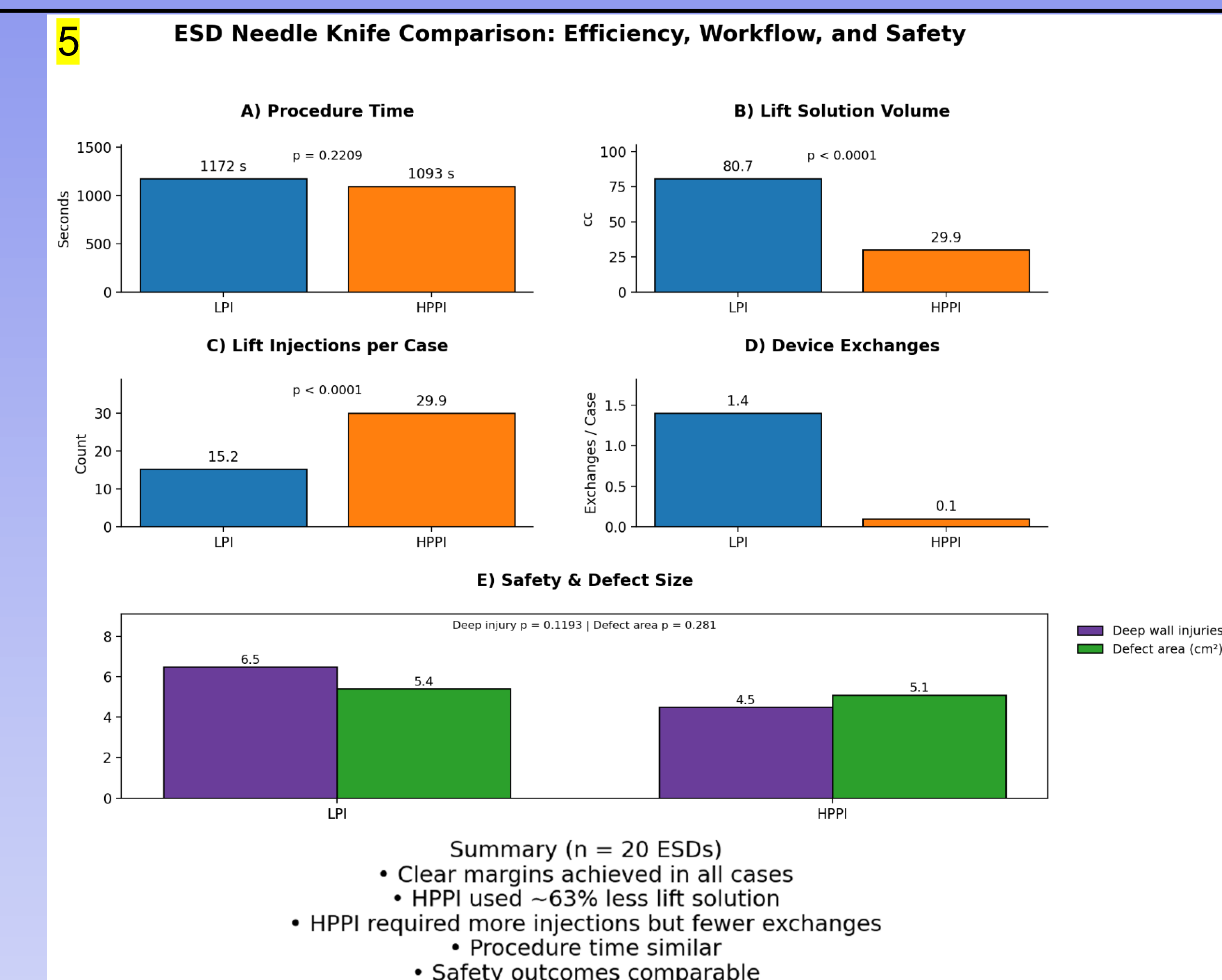
- 1) Bovine colon model
- 2/3) Simulated lesions and training model
- 4) Catheter device tips
- 5) Needle Knife Data Comparison

Methods

Endoscopic submucosal dissection (ESD) of 2-cm diameter simulated lesions was performed in ex vivo bovine calf large bowel (Fig 1). Lesions were created by branding the mucosal surface via a colotomy (subsequently closed) using a heated circular wire to create a tattoo. Lesions were positioned in pairs 10–30 cm from the anus (Fig 2). Resections were carried out using either a low-pressure injection (LPI) needle knife or a high-pressure punctureless injection (HPPI) needle knife (Fig 4). A pediatric colonoscope fitted with a dissection cap was used for all procedures, and normal saline used as the lifting agent. Two to six lesions were resected per colon specimen. For each pair of lesions, the LPI and HPPI knives were used in alternating fashion to minimize location-related bias. Standard ESD technique was used for mucosal incision and submucosal dissection in all cases. Procedural parameters tracked included: total case length, lift solution volume utilized, number of lift injections required, number of device exchanges, area of the mucosal defect, number of mucosal or submucosal tears/rents, and occurrence of deep wall injuries. Statistical comparisons between groups were performed using one- or two-tailed t-tests where appropriate.

Results

Twenty ESDs (10 LPI, 10 HPPI) were performed in 4 ex-vivo colons (2–6 ESDs per colon). Resection with clear margins was accomplished in all cases. Although procedures performed with the HPPI knife were approximately 8% faster, the mean procedure time was similar between the HPPI and LPI groups (1093 vs 1172 seconds, $p = 0.2209$). The ERBE HPPI knife required significantly less lifting solution than the LPI knife (29.9 cc vs 80.7 cc, $p < 0.0001$). Notably, more HPPI lift injections were made per case compared with LPI injections (29.9 vs 15.2, $p < 0.0001$). Device exchanges were markedly fewer with HPPI, averaging 0.1 exchanges per case compared with 1.4 exchanges per case with the LPI knife. Fewer deep wall injuries were also observed with HPPI (4.5 vs 6.5, $p = 0.1193$). The mean mucosal defect area was similar between groups (5.4 cm² vs 5.1 cm², $p = 0.281$).



Conclusion

Comparable resections were achieved with both the LPI and HPPI knives, and overall case duration was similar between groups. Notably, significantly less lift solution was required with the HPPI knife, although a greater number of individual lift injections were performed per case (Fig 5). We hypothesize that the HPPI method allows for more controlled and efficient augmentation of the submucosal lift and that foot pedal–controlled injection facilitates rapid reinjection compared with syringe-based injections required with the LPI system. These features may streamline lift maintenance during dissection. A larger study is in progress to increase the sample size and statistical power of this analysis to further evaluate these findings and confirm or refute these observations.

References

1. MCao Y, Liao C, Tan A, Gao Y, Mo Z, Gao F. Meta-analysis of endoscopic submucosal dissection versus endoscopic mucosal resection for tumors of the gastrointestinal tract. *Endoscopy* 2009; 41: 751–7.
2. Mitra N, Yan X, Cekic V, Shantha Kumara HMC, Whelan RL. Use of a manually operated combined needle knife/injection catheter for colonic ESD eliminates the need for instrument exchanges. VideoLoop presentation. SAGES 2020 Annual Meeting; 2020 (Virtual). Program No. V117; Abstract ID 101185.