

**EMR+ facilitates en bloc resection of larger lesions compared to conventional EMR. The technique shows its best discriminatory power for 3 cm lesions and can therefore close a therapeutic gap with manageable time and technical complexity.**

- **Methods:** Standardized lesions (1 cm, 2 cm, 3 cm, 4 cm) were created in an ex-vivo pig stomach. 152 lesions were resected by either conventional EMR (N=76) or EMR+ (N=76).
- **Results:** In lesions of 1 cm, both EMR and EMR+ were very reliable with a R0 resection rate of 100 %. In 2 cm lesions, EMR already dropped to 54.55 %. Classical EMR did not provide sufficient resection rates for lesions with 3 cm or even 4 cm (18.18 % and 0 %). EMR+ still presented very satisfying results in 3 cm lesions (86.36 %) but also relevantly decreased at 4 cm (60.00 %). From 3 cm on, EMR + was significantly faster than conventional EMR. A perforation rate of 15 % was observed in the 4- cm-group treated with EMR+. The resection area (cm<sup>2</sup>) was significantly larger for 1, 2, 3 and 4 cm lesions when using EMR+.

Knoop, R. F., Wedi, E., Petzold, G., Bremer, S. C., Amanzada, A., Ellenrieder, V., Neesse, A., Kunsch, S. (2020). **Endoscopic mucosal resection with an additional working channel (EMR+) in a porcine ex vivo model: a novel technique to improve en bloc resection rate of snare polypectomy.** *Endoscopy International Open*, 08(02). doi: 10.1055/a-0996-8050

### **Successful removal of a large pedunculated polyp with EMR+.**

A case is presented of a 64-year-old man with a large pedunculated polyp (Paris0-Ip, 2×1×5cm) with a broad base in the rectosigmoid. The polyp showed high mobility and was in an unfavourable location behind a colonic fold. Conventional EMR was not feasible, therefore EMR+ was performed and successfully carried out.

Wedi, E., Knoop, R., Jung, C., Ellenrieder, V., & Kunsch, S. (2019). **Use of an additional working channel for endoscopic mucosal resection (EMR+) of a pedunculated sessile serrated adenoma in the sigmoid colon.** *Endoscopy*, 51(03), 279–280. doi: 10.1055/a-0809-4814

### **EMR+ is a resection technique which is safe and effective and easy and fast to perform.**

- **Methods:** In an ex-vivo model the technique was developed and afterwards evaluated in vivo. 30 mm lesions were resected using EMR+ with a 35 mm snare and LiftUp (with pre-injection of saline solution). Main measurements were procedure time, macroscopic en bloc resection and adverse events.
- **Results:** For the 22 resections ex-vivo median procedure time was 7 min. and median size was 30x26x11mm. For the 13 in vivo resections median procedure time was 5 min and median size was 35x35x11mm. Macroscopic complete resection was achieved in 92.3 % (in vivo). One minor periprocedural bleeding but no major adverse events occurred.

Meier, B., Wannhoff, A., Klinger, C., & Caca, K. (2019). **Novel technique for endoscopic en bloc resection (EMR+) – Evaluation in a porcine model.** *World Journal of Gastroenterology*, 25(28), 3764–3774. doi: 10.3748/wjg.v25.i28.3764

### **Successful resection of a laterally spreading tumor in the colon using EMR+ technique.**

A case is presented of a 75-year-old patient with tattoo-marked lesions in the colorectum. A laterally spreading tumor of non-granular type with pseudodepression (LST-NG/PD) and 20 mm size was found in the transverse colon. For such types of lesions en-bloc resection is recommended. Therefore, resection was carried out by using the EMR+ technique with AWC, 30 mm snare and tissue anchor. The final pathology assessment revealed low-grade intraepithelial neoplasia and wide R0 margin status. Hence, EMR+ can be used to safely perform rapid and easy-to-achieve en-bloc resections.

Zimmer, V. (2019). **Gastrointestinal: Additional working channel-assisted endoscopic mucosal resection (EMR+): A novel tool for en bloc resection of colorectal lesions.** *Journal of Gastroenterology and Hepatology*. doi: 10.1111/jgh.14951

**LiftUp® not only is a safe alternative to conventional injection solutions, but also shows an improved lifting effect and significantly less volume needed.**

- **Methods:** In a prospectively randomized study 60 artificial lesions (3x3 cm) were set in an ex-vivo stomach and resected by ESD. Three different injection solutions were used (LiftUp, HAES, saline solution) and compared in terms of: en bloc resection rate, perforation rate, lifting properties, injection time, injection volume, ESD time and overall procedure time.
- **Results:** Using LiftUp no procedure-related perforations occurred, lifting was adequate in 80% and 95% were en bloc resections. For HAES one perforation was observed, 30% adequate lifting and 100% en bloc resection. In case of saline solution 2 perforations occurred, lifting was adequate in 30 % and 80% of the resections could be carried out en bloc. Although no significant difference in ESD and overall procedure time was observed, there was a visible trend towards lower ESD procedure time with LiftUp. Additionally, injection volume needed when using LiftUp was significantly lower compared to the other injectables.

Wedi, E., Koehler, P., Hochberger, J., Maiss, J., Milenovic, S., Gromski, M., Ho, C.-N., Gabor, C., Baulain, U., Ellenrieder, V., Jung, C. (2019). **Endoscopic submucosal dissection with a novel high viscosity injection solution (LiftUp) in an ex vivo model: a prospective randomized study.** *Endoscopy International Open*, 07(05). doi: 10.1055/a-0874-1844

**LiftUp® is feasible for different resection techniques as it provides high and long-lasting elevation. Use of LiftUp® could fasten up resection and make en bloc resection safer.**

- **Methods:** In total 63 injections and resections (42 in the UGI; 21 in the LGI) were carried out in 7 animals. Lesions with  $\geq 2$ cm were resected with different techniques: EMR (41.3%)/EMR+ (39.7%)/ESD (17.5%)/h-ESD (1.6%). After one and four weeks a follow-up was performed. Histopathological evaluation was done after four weeks.
- **Results:** The resected specimen were between 1.6 and 4.8 cm in terms of size. LiftUp showed a safe application and no negative effects on wound healing. Only two perforations (3.2%) and no major bleeding occurred. In 90.5 % reinjection was not necessary and in 98.8% no procedural complications were observed. Histopathological evaluation showed normal wound healing. Although LiftUp was intentionally injected through the organ wall, it was not detectable in the mediastinum.

Wedi, E., Ho, C.-N., Conrad, G., Weiland, T., Freidinger, S., Wehrmann, M., Meining, A., Ellenrieder, V., Gottwald, T., Schurr, MO., Hochberger, J. (2019). **Preclinical evaluation of a novel thermally sensitive co-polymer (LiftUp) for endoscopic resection.** *Minim Invasive Ther Allied Technol*, 28(5), 277–284. doi: 10.1080/13645706.2018.1535440

**The EMR+ technique could improve the efficiency of mucosal resection, after going through the respective learning curve.**

- **Methods:** A prospectively randomized pre-clinical ex-vivo pilot study in ex-vivo porcine stomachs was carried out. Flat lesions with a standardized size of 3 × 3 cm were set and resected with either EMR+ or ESD.
- **Results:** The EMR+ group showed significantly shorter procedure time (median 10.5 min, range 4.4–24 min) compared to the ESD group (median 32 min, range 14–61.6 min,  $p < .0001$ ). Compared to ESD the rate of en bloc resection was significantly lower in the EMR + group (38 % vs. 95 %) ( $p < .0001$ ). After the first 12 procedures subsequent en bloc resection rate of 100% was reached due to improvement in the learning curve.

Wedi, E., Knoop, R., Jung, C., Gromski, M., Ho, C. N., Conrad, G., Maiss, J., Milenovic, S., Klemme, D., Baulain, U., Seif Amir Hosseini, A., Ellenrieder, V., Koehler, P. (2019). **EMR+ with the AWC improves endoscopic resection speed compared to ESD: a porcine ex-vivo pilot study.** *Minimally Invasive Therapy & Allied Technologies*, 1–8. doi: 10.1080/13645706.2019.1673778

**For flat lesions, which due to their size cannot be safely resected by EMR, ESD+ is a promising resection method, showing a significant advantage over traditional ESD in terms of procedure time and complication rate in the ex vivo model.**

- **Methods:** In an ex-vivo setup standardized lesions of 3 and 4 cm were set and 64 were resected with ESD (N=32) and ESD+ (N=32).
- **Results:** The procedure time using ESD+ was significantly shorter compared to ESD (median 24.5 min vs. 32.5 min) especially in retroflex position. Also damage of muscular layer occurred significantly less using ESD+ (ESD+:1/32 vs. ESD:6/32; p = 0,04).

Knoop, R., Wedi, E., Ellenrieder, V., Neesse, A., Kunsch, S. (2019). **Endoskopische Submukosadissektion mit einem zusätzlichen Arbeitskanal (ESD+) als neue Methode zur Verbesserung der traditionelle ESD im Ex-vivo-Model.** Z Gastroenterol 2019; 57(09): e361. doi: 10.1055/s-0039-1695572

**The additional working channel (AWC®) enables endoscopic resection of large lesions by providing distinct traction and counter-traction.**

- **Methods:** Resection was done by EMR+ in 4 patients and ESD+ in 4 patients. The injection solution used was saline solution and resection was carried out by using a 40 mm snare and the AqaNife.
- **Results:** Out of 8 resections, 3 were located in the stomach and 5 in the lower GI tract. Whereas 2 piecemeal resections (large lesions with 45 mm diameter) had to be done, the other 6 lesions were resected en bloc. The average of macroscopic estimated lesion size was 35.9 mm. The mean procedure time (scope-in to scope-out) was 68.5 min. Acute arterial bleeding post-EMR occurred in two cases.

Walter, B., Schmidbaur, S., Krieger, Y., & Meining, A. (2019). **Improved endoscopic resection of large flat lesions and early cancers using an external additional working channel (AWC): a case series.** Endoscopy International Open, 07(02). doi: 10.1055/a-0824-6912

**The Traction Polypectomy Snare facilitates the removal of flat polyps and reduces the number of specimens during piecemeal resection to a minimum, allowing a better histopathological assessment.**

- **Methods:** 70 artificial sessile tumors were created in a porcine ex vivo colon. Thereof 35 were resected with new serrated snare (Traction Polypectomy Snare) and 35 using an identical snare without teeth.
- **Results:** Using the serrated snare 31% more tissue could be removed with a single snare resection.

Prosst, R. L., & Baur, F. E. (2010). **A new serrated snare for improved tissue capture during endoscopic snare resection.** Minimally Invasive Therapy & Allied Technologies, 19(2), 100–104. doi: 10.3109/13645701003642768

