Images:
Radiofrequency Ablation of Barrett’s Esophagus using the HALO system
HALO$^{\text{FLEX}}$ System

*(generator and footpedal)*
HALO$^{360}$ sizing catheter
HALO\textsuperscript{360+} ablation catheter
Human torso with ablation catheter
HALO$^{90}$ ablation catheter
HALO\textsuperscript{90} catheter on endoscope
HALO cleaning cap
HALO cleaning cap
HALO\textsuperscript{90} generator delivers radiofrequency energy, resulting in uniform, controlled ablation (~500 microns deep), due to:

- Automated RF energy delivery;
- Fixed amount RF energy density;
- Fixed power;
- Bipolar electrode array.
**TREATMENT PROTOCOL**

1. **HGD/EC in BE**
2. **ER of any visible lesion**
3. **Primary HALO\(^{360}\) ablation**
   - **HALO\(^{360/90}\) ablation**
     - every 2 months
     - max. 2x HALO\(^{360}\)
     - max. 3x HALO\(^{90}\)
4. **Residual BE epithelium?**
   - **YES**
     - **Escape ER**
   - **NO**
     - **EGD with NBI/Lugol and 4Q/1cm biopsies**
HALO$^{360}$ ablation (I)

Endoscopic appearance of a circumferential ablation procedure using the HALO$^{360}$ system. A: C8M9 Barrett esophagus with HGD. B: The HALO$^{360+}$ catheter is introduced and inflated at the upper end of the Barrett segment. C: After the first application of energy the whitish coagulum resulting from the ablation shows after the catheter is deflated and advanced distally. D: After ablation of the whole Barrett segment and cleaning of the electrode and ablation zone, the catheter is reintroduced for a second ablation pass. E: The second ablation pass results in a tan colored ablation zone. F: Treatment effect after two circumferential ablation passes. Reproduced with permission of www.endosurgery.eu.
**HALO\textsuperscript{360} ablation (II)**

A: C5M6 Barrett esophagus with high-grade dysplasia; B: The HALO\textsuperscript{360}+ catheter is introduced and inflated at the upper end of the Barrett segment; C: After the first application of energy the whitish coagulum resulting from the ablation shows after the catheter is deflated and advanced distally; D: After ablation of the whole Barrett segment and cleaning of the electrode and ablation zone, the catheter is reintroduced for a second ablation pass; E: The second ablation pass results in a tan colored ablation zone; F: Treatment effect after two circumferential ablation passes. Reproduced with permission of www.endosurgery.eu.
HALO$^{360}$ ablation (III)
Introduction of the HALO\textsuperscript{90} catheter

1) The leading edge of the HALO cap is visible proximal to the arytenoids; 2) A biopsy forceps is blindly advanced behind the arytenoids into the proximal esophagus; 3) The endoscope is angulated downward, causing the leading edge of the HALO cap to touch the shaft of the biopsy forceps; 4) After gently advancing the endoscope, using the biopsy forceps for guidance, the proximal esophagus is entered. Reproduced with permission from www.endosurgery.eu.
HALO\textsuperscript{90} ablation (I)

A: Residual Barrett mucosa islands after one circumferential ablation treatment; B: Ablation effect immediately after ablation with the HALO\textsuperscript{90} system; the distal end of the catheter is visible at the 12 o'clock position in the endoscopic field; C: Endoscopic appearance after the first ablation pass (2x 15 J/cm\textsuperscript{2}) and cleaning of the ablation zones; D: After the second ablation pass (2x2 15 J/cm\textsuperscript{2}) the ablation zones have a tan-colored appearance.

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HALO\textsuperscript{90} ablation (II)

Endoscopic appearance of a focal ablation procedure using the HALO\textsuperscript{90} system. A: Antegrade view of an initial C6M7 Barrett esophagus 6 weeks after primary circumferential ablation; B: Residual isles of Barrett mucosa; C: Corresponding image with NBI; D: Ablation effect immediately after ablation with the HALO\textsuperscript{90} system; the distal end of the catheter is visible at the 12 o’clock position in the endoscopic field; E: Endoscopic appearance after the first ablation pass (2x 15 J/cm\textsuperscript{2}) and cleaning of the ablation zones; F: After the second ablation pass (2x2 15 J/cm\textsuperscript{2}) the ablation zones have a tan-colored appearance. Reproduced with permission of www.endosurgery.eu.
**HALO\(^{90}\) ablation (III)**

**A:** Antegrade view of an initial C6M7 Barrett esophagus after one circumferential and one focal ablation session; **B:** Upon detailed endoscopic inspection with high-resolution white light endoscopy 2 minute isles with residual isles of Barrett mucosa are identified; **C:** Corresponding image with narrow band imaging; **D:** Ablation effect immediately after ablation with the HALO\(^{90}\) system; the distal end of the catheter is visible at the 12 o’clock position in the endoscopic field; **E:** Endoscopic appearance after the first ablation pass (2x15 J/cm\(^2\)) and cleaning of the ablation zones; **F:** Tan-colored ablation zones after the second ablation pass (2x2 15 J/cm\(^2\)). Reproduced with permission of www.endosurgery.eu.
Circumferential HALO\textsuperscript{90} ablation of the Z-line

A, B: High-resolution white light inspection of the neosquamocolumnar junction after primary circumferential ablation. Differentiating Barrett mucosa from cardia mucosa is, however, difficult. C: Corresponding image with narrow band imaging; D: To ensure eradication of all intestinal metaplasia at the top of the gastric folds, the entire circumference is ablated using the HALO\textsuperscript{90} system. After the first ablation pass (2x 15 J/cm\textsuperscript{2}) whitish coagulum can be seen. E, F: After cleaning of the ablation zone and electrode surface, the entire neosquamocolumnar junction is ablated a second time (2x2.15 J/cm\textsuperscript{2}). Reproduced with permission of www.endosurgery.eu.
Follow-up after RFA of BE

A. High-resolution white light image of an initial C9M10 Barrett segment, completely regenerated with neosquamous epithelium after successful treatment with radiofrequency ablation; B. Corresponding narrow-band imaging view; C. 4 quadrant biopsies are obtained for every 1-2 cm over the entire length of the initial Barrett segment; D. A normal appearing neosquamocolumnar junction; E. Corresponding narrow-band imaging view; F. To histologically confirm the absence of intestinal metaplasia, 4 quadrant biopsies are obtained 5 mm distal to the neosquamocolumnar junction. Reproduced with permission of www.endosurgery.eu.
ER followed by RFA (I)

A: Antegrade view on a C6M10 Barrett esophagus; B: A lesion suspicious for early cancer at the 2-4 o’clock position; C: View on the resection wound after endoscopic resection of the lesion in two pieces; D: Histopathological evaluation of the specimens showed a radically resected adenocarcinoma infiltrating in the muscularis mucosae (T1m3); E: Same area 6 weeks after the endoscopic resection. The wound has healed completely with scarring; F: Ablation effect after primary circumferential ablation using the HALO360 system (2x 12 J/cm²); G: Residual isle of Barrett mucosa remaining 6 weeks after prior circumferential ablation; H: After additional focal ablation of residual isles of Barrett mucosa, complete removal of the whole Barrett segment was reached. Reproduced with permission of www.endosurgery.eu.
ER followed by RFA (II)

Figure 7: Endoscopic images of a C3M5 Barrett esophagus with HGD and a visible lesion treated with a combination of ER and RFA. A: Antegrade view on a C3M5 Barrett esophagus, with a flat type lesion at the 6-7 o'clock position; B: View on the resection wound. The specimen showed HGD; C: Same area 6 weeks after the ER. The wound has healed completely with scarring; D: Ablation effect after primary circumferential ablation using the HALO360 system (2x 12 J/cm²); E: Residual isle of Barrett mucosa remaining 6 weeks after prior circumferential ablation; F: Effect immediately after ablation with the focal ablation device (2x2 15 J/cm²); G: Complete removal of the whole Barrett segment; H: Corresponding NBI image. Reproduced with permission of www.endosurgery.eu.
Stepwise circumferential and focal radiofrequency ablation (RFA) for eradication of Barrett esophagus with high-grade dysplasia. A, B. A C7M8 Barrett segment with inconspicuous high-grade dysplasia. C. The HALO360 catheter is introduced and after the first application of energy (12J/cm²), the whitish coagulum resulting from the ablation shows after the catheter is deflated and advanced distally. D. After ablation of the whole Barrett segment and cleaning of the electrode and ablation zone, the catheter is reintroduced for a second ablation pass (2, 12J/cm²). E. Eight weeks after primary circumferential ablation, a 15mm large residual island of Barrett mucosa is observed. F. The island is ablated using the cap-based HALO90 system for focal ablation (2x2, 15J/cm²). G, H. Eight weeks after secondary focal ablation, the esophagus is completely covered with normal appearing neosquamous epithelium. Images courtesy Jacques Bergman MD and www.endosurgery.eu
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