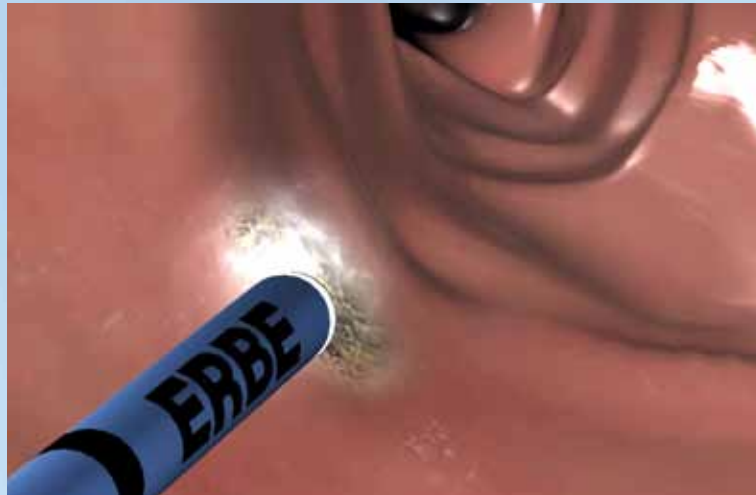


USER BROCHURE FOR GASTROENTEROLOGY



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# INTRODUCTION

High-frequency alternating current has a variety of surgical applications and is used for open, laparoscopic and endoscopic techniques. The electrosurgery unit is programmed with modes for functions such as cutting, coagulation, devitalization and thermofusion. The unit and probes apply current to the target tissue, producing the following tissue effects as a function of temperature (see table 1):

**Important:**

*While ERBE Elektromedizin GmbH has taken extreme care in preparing these recommended settings, we cannot completely rule out errors. The information and data contained in the recommended settings cannot be used to justify any claims against ERBE Elektromedizin GmbH. In the event of compelling legal justification for a claim, liability shall be limited to intent and gross negligence.*

*Although information on recommended settings, application sites, duration of application and the use of instruments is all based on clinical experience, individual centers and physicians may prefer settings other than those recommended here. These settings are merely intended as guidelines that the surgeon is free to assess for applicability. Depending on individual circumstances, surgeons may need to depart from the information provided in this brochure.*

*Medicine is constantly subject to new developments arising from research and clinical experience.*

*This can represent yet another reason for departing from the information provided here.*

Tissue temperature	Effect
40 – 50 °C	Hyperthermia Changes: to the cell membrane and to the internal molecular structures of the cell
approx. 60 °C	Coagulation of internal cell proteins, devitalization
approx. 80 °C	Coagulation of extracellular collagen, destruction of cell membranes
approx. 100 °C	Evaporation of tissue fluids (desiccation, drying); tissue shrinkage
approx. 150 °C and above	Carbonization (charring)
approx. 300 °C and above	Vaporization (evaporation of the entire tissue)

Table 1: Thermal effects on biological tissue

Source: J. Helfmann, Thermal effects. In: H.-Peter Berlien, Gerard J. Müller (ed.); Applied Laser Medicine. Springer-Verlag Berlin Heidelberg, 2003.

**Endoscopic applications in electro-surgery**

When performing endoscopic procedures of the gastrointestinal tract (GIT), the key advantages of conventional electro-surgery are that surgeons can work with flexible electro-surgical tools and probes, make incisions without applying pressure and, at the same time, staunch bleeding. Endoscopic techniques are now virtually the only method used for polypectomies and papillotomies. Argon plasma coagulation, a special form of electro-surgery, uses endoscopy to staunch bleeding and devitalize tissue lesions with no direct contact between the instrument and tissue. Optimized for these endoscopic procedures in the GIT, the VIO-GI Workstation is a complete system that includes hardware, software and a large selection of probes and instruments.

The fully equipped version of the system consists of the electro-surgery unit (VIO 300 D/VIO 200 D) as the master module, units for argon plasma coagulation (APC 2) and waterjet surgery (ERBEJET 2), and an endoscopic flushing pump that can be used to flush the area under examination to improve visibility.

The functions of the individual modules are described in the mode/application overview sections.

VIO® 300 D

APC 2

ERBEJET® 2

EIP 2

Gastroenterology workstation:  
includes instruments for electro-  
surgery, argon plasma coagulation,  
waterjet surgery and  
endoscopic flushing



See <sup>10</sup> for more information

# THERMAL EFFECTS

## Cutting

Voltages of 200 V or more ignite a spark between the electrode and tissue. This electrical energy produces temperatures of 100 °C and higher for cutting mode, causing intra- and extracellular fluids to vaporize so quickly that the cell membranes and cell layers rupture. The result is a cut.

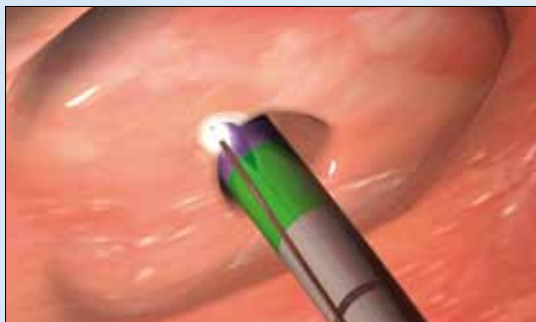


Figure 1:  
Endoscopic cutting, shown here during a papillotomy

## Coagulation

Coagulation current is used to staunch bleeding. Converting electrical energy to heat results in coagulation temperatures of 60 to 100 °C, vaporizing fluids and causing the tissue to dry out and shrink. Coagulation points can also be used to mark a tissue lesion.



Figure 2:  
Coagulation points are used to mark a tissue lesion; the coagulation current staunches the bleeding

## Devitalization

This electrosurgical technique is used to target specific tumors and destroy them. Cell damage is irreversible at temperatures of 50 to 60 °C or more.



Figure 3:  
Example of APC application to devitalize a tumor

## Thermofusion

Thermofusion is a reliable means of sealing vessels and tissue bundles, after which the sealed tissue can be cut away either mechanically or using electrosurgical techniques. This method is increasingly replacing the clip and suture method.

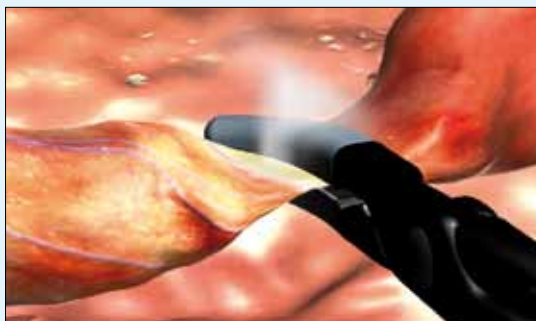


Figure 4:  
Using thermofusion for safe vascular sealing with no clips or sutures

See reverse for more information <sup>1,2</sup>

# ELECTROSURGICAL PROCEDURES

## Monopolar technique

In monopolar electrosurgery, high-frequency current ( $i_{HF}$ ) flows in a closed loop, first from the unit to the instrument, then through the patient's body to the patient plate, and finally from the patient plate back to the unit (fig. 5). The surgical effect is produced at the tip of the active electrode, which, due to its relatively small contact surface, is the point in the circuit with the highest current density. The second electrode, i.e., the patient plate, covers a large area and is placed against the patient's skin at an appropriate location in order to discharge current.

At the points of application, the high current density and resulting heat produce effects such as an incision or coagulation. The low current density across the large surface of the patient plate, by contrast, makes heating here insignificant.

### Safety issues with endoscopic, monopolar electrosurgery

Two components – the NESSY patient plate safety system and the NESSY  $\Omega$  patient plate – reduce the safety risks involved in endoscopic, monopolar electrosurgery.

NESSY tests the two-piece patient plate to determine whether it has been positioned correctly and whether its entire surface is in contact with the patient. NESSY also constantly compares the currents flowing through the two surfaces of the plate (fig. 6).

If only slight differences are recorded, the system can still be activated. If NESSY detects major differences, however, it will produce a warning signal and interrupt activation (the display will show a red light). To prevent thermal necrosis, the surgical system cannot be reactivated until the patient plate is correctly positioned against the patient.

### Simple and safe application with NESSY $\Omega$

The NESSY  $\Omega$  patient plate makes positioning easier. The surrounding, insulated equipotential ring of the NESSY  $\Omega$  means that this patient plate can be positioned in any direction (fig. 7a+b). Current is distributed evenly across the two inner contact surfaces. Because the overall contact surface is smaller than that of conventional electrodes, the NESSY  $\Omega$  is easier to position against the patient's body, making it universally applicable for children and adults alike.

We recommend using NESSY  $\Omega$  to maximize the safety of monopolar electrosurgery.

See <sup>7</sup> and the NESSY checklists given in the brochure appendix for more information.

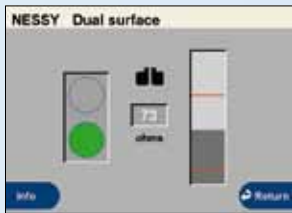


Figure 6:  
VIO display with a NESSY "green light":  
The system can be activated

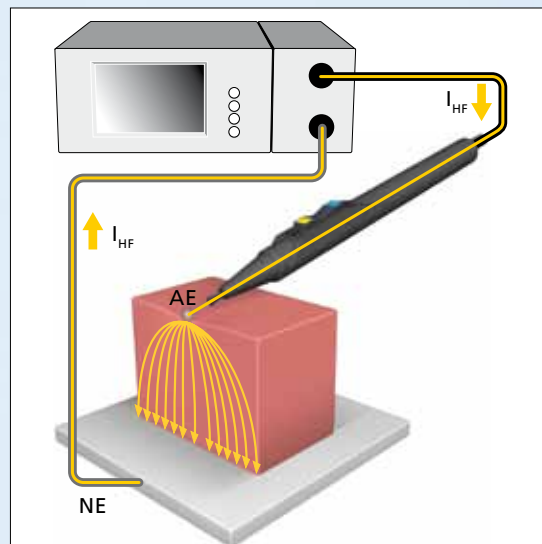
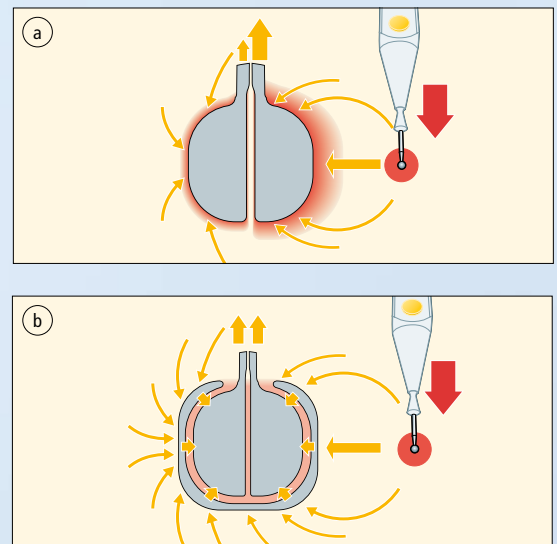


Figure 5:  
Circuit for monopolar electrosurgery

Figure 7a:  
Incorrectly connecting the patient plate (NE=neutral electrode; AE=active electrode) generates high current density on the side closest to the operating field

Figure 7b:  
The NESSY  $\Omega$  can be positioned in any direction and prevents heat from building to one side



### Bipolar technique

Bipolar electrosurgery instruments have two integrated active electrodes. Current flows only in the area of tissue between the two poles and not through the patient's body (fig. 8). Bipolar electrosurgery does not require the use of a patient plate.

### Argon plasma coagulation (APC)

In APC, ionized argon gas carries the high-frequency (HF) current to the target tissue with no contact between the instrument and the tissue.

The process results in few complications, safely staunches bleeding, produces homogeneous surface coagulation and allows the surgeon to adjust penetration depth. Because it is a non-contact procedure, one advantage of APC is that the distal end of the instrument cannot adhere to the coagulated tissue and tear open the scab that has formed. The plasma beam – as well as the tissue effect – depends on the type of probe. Other factors influencing this effect include the APC mode and the duration of the APC procedure.

See <sup>3</sup> for more information. Recommendations for applying APC are provided in the checklist given in the brochure appendix.

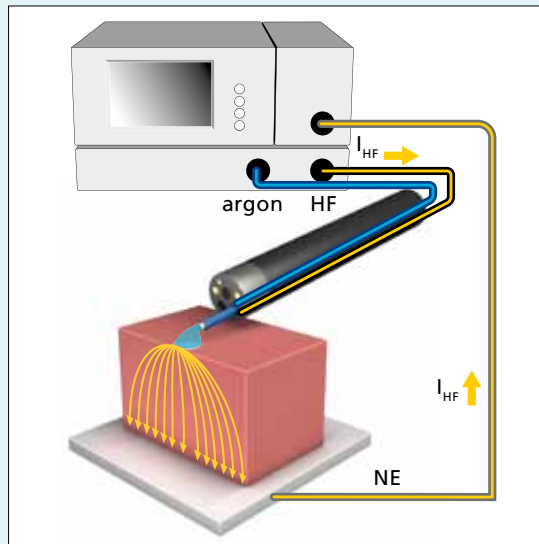
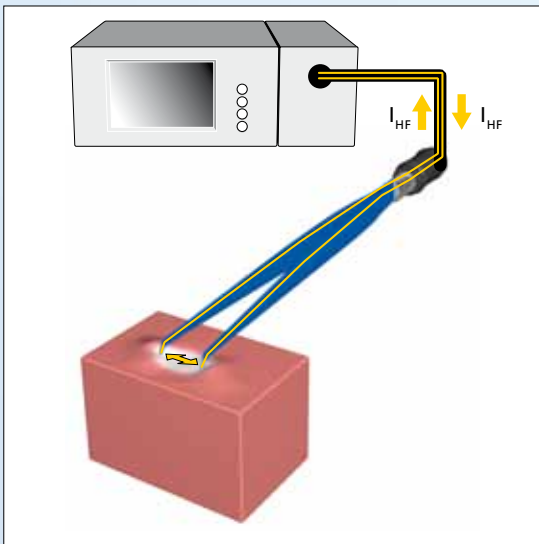
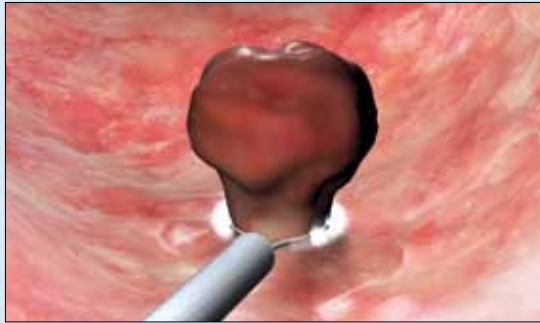


Figure 8:  
Circuit for bipolar  
electrosurgery

Figure 9:  
Circuit for monopolar APC  
applications

## CUTTING AND COAGULATION MODES

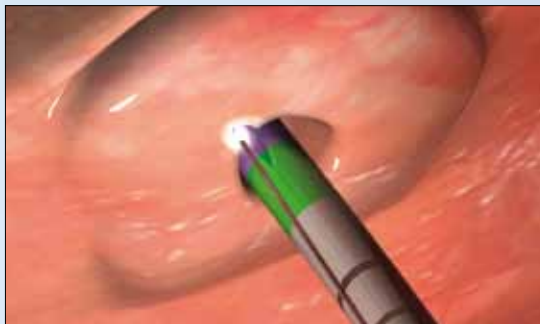
Figure 10:  
Use of ENDO CUT Q mode for an  
endoscopic polypectomy



### ENDO CUT Q

ENDO CUT Q fractionates the cutting process into cutting and coagulation intervals for procedures such as endoscopic polypectomy using a snare, or for EMR or ESD using a HybridKnife. Cutting and coagulation cycles can be adjusted individually to minimize the risks of a polypectomy, such as bleeding if coagulation is insufficient, or perforation if coagulation is too intense. See <sup>4</sup> for more information.

Figure 11:  
Use of ENDO CUT I mode for an  
endoscopic papillotomy



### ENDO CUT I

Uses for the ENDO CUT I fractionated cutting mode include papillotomies or other endoscopic needle or wire applications. For papillotomies or sphincterotomies, cutting and coagulation cycles can be adjusted individually to minimize risks such as the zipper effect (uncontrolled cutting of the papilla). See <sup>5</sup> for more information.

Figure 12:  
Use of FORCED APC mode to  
mark a lesion



### FORCED APC

This argon plasma coagulation mode delivers high energy to the target tissue to effect deep coagulation and effective devitalization.

Figure 13:  
Use of PRECISE APC mode in  
treating an angiodysplasia



### PRECISE APC

Unlike FORCED APC, PRECISE APC works in the low-frequency range. This allows the surgeon to make subtle modifications to the dosage, resulting in uniform coagulation throughout the target tissue, regardless of the distance between the probe and the tissue.

### PULSED APC

This APC mode is based on pulsed (on-off) activation. PULSED APC is versatile and can be used both for coagulation and for tissue devitalization. The favorable dosing characteristics of PULSED APC result in homogeneous tissue effects.



Figure 14:  
Use of PULSED APC mode in treating an angiodysplasia of the colon

### SOFT COAG

SOFT COAG is a gentle, conventional form of coagulation for deep tissue penetration that minimizes adhesion between the electrode and the coagulated tissue.

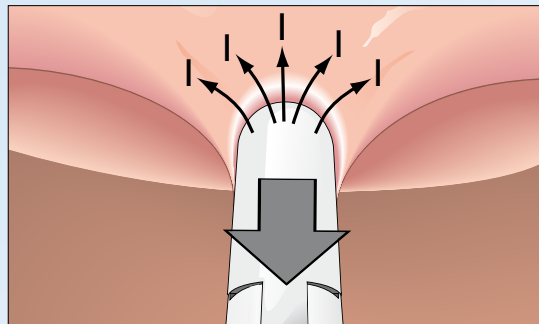


Figure 15:  
SOFT COAG can be used to induce coagulation for small hemorrhages

### FORCED COAG

This mode of coagulation provides fast, effective standard coagulation with thermal penetration to a medium depth.

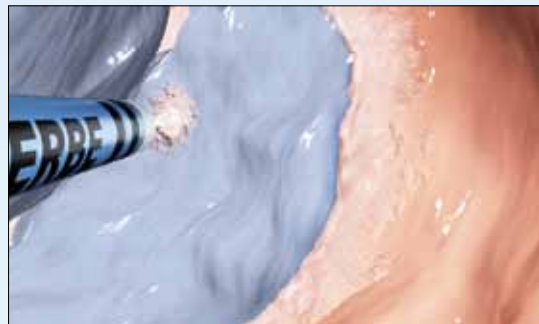


Figure 16:  
Example of a FORCED COAG application: post-operative coagulation of bleeding during an ESD procedure

### DRY CUT

The modulated forms of current used for DRY CUT mode provide a remarkable degree of hemostasis during cutting procedures.

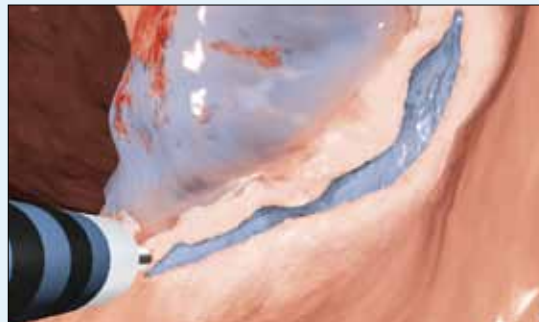


Figure 17:  
DRY CUT delivers current in forms that are ideal for ESD

See <sup>1,2</sup> for more information

# INSTRUMENTS



Figure 18:  
The connecting cable and  
filter are completely integrated  
in FiAPC probes



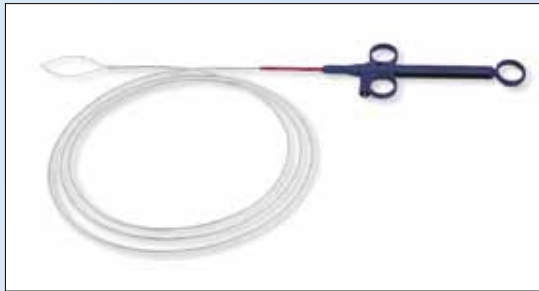
## APC probes

Flexible APC probes are positioned over the target area of the gastrointestinal tract through an endoscope. When high-frequency alternating current is applied at the distal end of the instrument, the current ignites the chemically inert argon gas to create an electrically conducting argon plasma.

Available in various diameters, lengths and discharge apertures, APC probes can be used for an extremely wide variety of applications in the gastrointestinal tract and offer a non-contact method of coagulating and devitalizing tissue. They are available as reusable probes or as disposable instruments. See <sup>3</sup> for more information.



Figure 19:  
Polypectomy snare



## FiAPC probes

Thanks to its integrated filter, the sterile FiAPC probe (fig. 18) helps prevent contamination caused by the return flow of secretions. FiAPC probes are available in various versions (length, diameter), with axial, lateral and circular argon gas outlets. ERBE FiAPC probes fit all commonly used types of flexible endoscope.

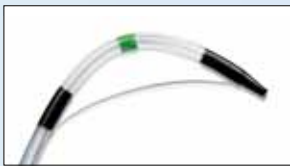


Figure 20:  
Papillotome



## Polypectomy snare

Polypectomy snares (fig. 19) are flexible instruments that can be fed into an endoscope and positioned over a polyp. Once the snare is laid over the base of a polyp, the user then activates the fractionated ENDO CUT Q cutting mode to resect the polyp. Polypectomy snares come in an extremely wide variety of shapes and designs, and are available as either disposable or reusable products. The snare is a round wire or flat strip consisting of either a single filament or of multiple filaments braided together. Its shape can be modified to be symmetrical or asymmetrical. Snares are usually oval or hexagonal.

## Papillotome/sphincterotome

A papillotome (fig. 20) is a flexible probe with a cutting wire at its distal end for dissecting papillae in the bile or pancreatic ducts. Papillotomes are available in a variety of models that differ largely in terms of the length of the cutting wire (20 or 30 mm long), tip configuration (normal or filiform) and format (single or multiple lumen design).

### CoagGrasper (coagulation forceps)

The CoagGrasper (fig. 21) can be used to staunch arterial bleeding by elevating the tissue slightly from the base and then using monopolar HF current to induce coagulation.

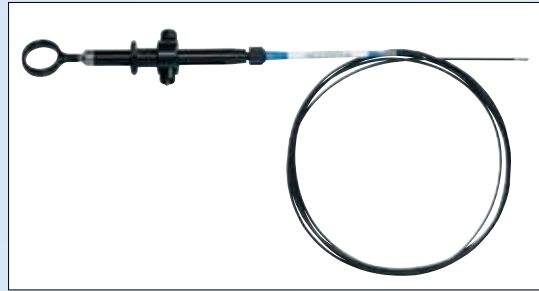


Figure 21:  
CoagGrasper (coagulation forceps)

### Injection needle

This flexible instrument is used for injecting lesions of the gastrointestinal tract by first feeding the injection needle (fig. 22) into the working channel of the endoscope and then inserting it into the target area. Tip geometry varies from one injection needle to another: blunt, for instance, for the lower gastrointestinal tract, or pointed for the upper GIT.

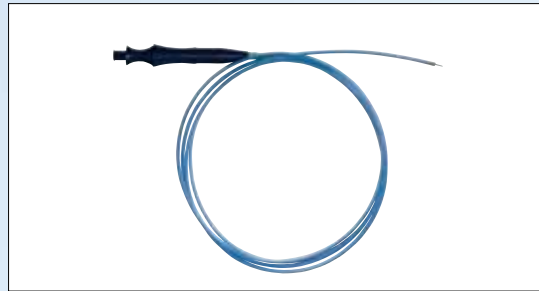


Figure 22:  
Example of an injection needle with a pointed tip

### Flexible waterjet probe

The flexible waterjet probe (fig. 23) is used to elevate the mucosa without the use of needles. The liquid flushed into the area forms a cushion in the submucosa that the surgeon can then replenish as needed using the HybridKnife. This minimizes the risk of perforation when preparing the lesion for subsequent EMR.



Figure 23:  
Flexible waterjet probe

### HybridKnife

The HybridKnife (fig. 24) is a multifunctional instrument suitable for use in procedures such as endoscopic submucosal dissection (ESD). Electrosurgery and waterjet surgery tools are integrated into the instrument, allowing surgeons to perform all 4 relevant ESD procedures – marking, elevation, incision/dissection and coagulation – without having to switch instruments. Integrating the waterjet feature gives surgeons the ability to replenish the submucosal elevation cushion at any time.



Figure 24:  
The entire instrument:  
HybridKnife (Type I, Type T)  
including handle and connecting  
cable

The distal end of the probe varies from one model to another:

- ✦ Type I: Wide variety of applications; considerable freedom of movement
- ✦ Type T: The model with the best properties for dissecting and working under tension; excellent coagulation properties

# APPLICATIONS

## Polypectomy

The fractionated ENDO CUT Q cutting mode was designed for removing gastrointestinal tumors in procedures such as polypectomies, mucosa resection or submucosa dissection.

Alternating intervals of cutting and coagulation can be adapted to the work habits of the gastroenterologist, to the shape of the polyp or lesion, and to the polyp snare. The overall cutting process results in a controlled incision while providing reliable hemostasis and keeping the risk of perforation low. The underlying principle is to stimulate as much coagulation as necessary (to prevent bleeding) yet as little as possible (to prevent perforation). Before the cutting and coagulation intervals begin, the base of the polyp is coagulated, after which the incision is made. See <sup>4</sup> for more information.

## Papillotomy

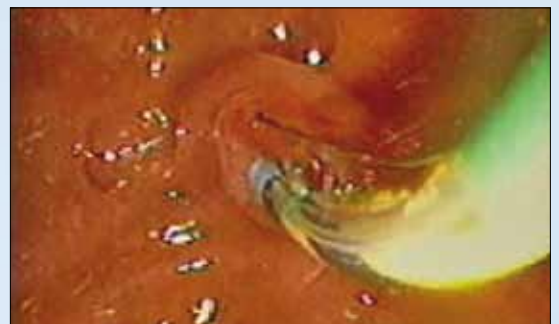
A papillotomy is an electrosurgical procedure in which the papilla of the bile duct (where the duct drains into the duodenum) is split apart by one to two centimeters.

This papillary opening allows surgeons to remove gallstones, for instance, using endoscopic techniques. ENDO CUT I mode works in fractionated CUT-COAG intervals to prevent an uncontrolled incision – an undesirable situation known as the “zipper” effect. Intervals can be customized depending on localization, the shape of the instrument and the work habits of the gastroenterologist. See <sup>5</sup> for more information.

Figure 25:  
Safely removing  
polyps using the ENDO CUT Q  
cutting mode



Figure 26:  
Safe dissection of the papilla using  
the ENDO CUT I cutting mode



### Endoscopic mucosal resection (EMR)

High-pressure elevation using the flexible waterjet probe causes fluid to build in the submucosa and form a bulge. This cushion, which is selective and limited to the submucosa, keeps the procedure at a safe distance from the muscularis and minimizes the risk of perforation during incision and excision of the lesion, both when performing ESD techniques or a snare resection. The surgeon can also replenish this liquid cushion as needed.

The EMR snare resection technique can only be used for removing lesions en bloc (i.e., in one piece) for lesions up to 2 cm in size. Lesions greater than 2 cm in diameter can only be removed using a successive partial resection technique (piecemeal method). Disadvantage: The risk of EMR is that surgeons may not be able to completely remove lesions greater than 2 cm in diameter and the resection edge may not be tumor free. Carcinogenic cells may also remain in the mucosa and histological analysis may be more difficult.

### Endoscopic submucosal dissection (ESD)

**ESD allows surgeons to remove even relatively large lesions in the intestinal tract in one piece (en bloc). Only an R0 resection provides the ideal circumstances for a successful cure, i.e., histological analysis must show that the lesion has been entirely resected.**

The first step in this procedure is to use the waterjet feature of the HybridKnife to elevate the mucosal lesion. The separation medium builds in the submucosa, forming a liquid cushion that allows the surgeon to work at a safe distance to the outer organ wall known as the muscularis. Tissue is resected by activating the electrosurgery feature of the HybridKnife with the support of VIO system modes. The two integrated features – waterjet surgery and electrosurgery – are the two main advantages that the HybridKnife method brings to ESD. Surgeons can use this multifunctional instrument to perform the individual steps of marking, elevation, incision/dissection and coagulation without changing instruments and while maximizing safety. See <sup>6, 8</sup> for more information.

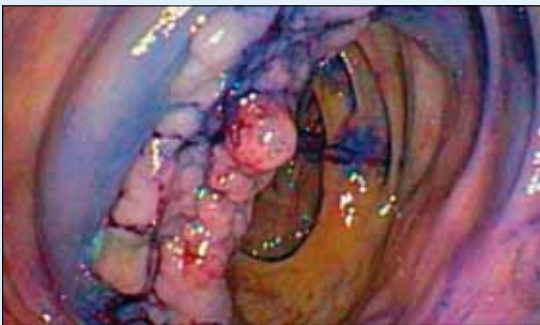
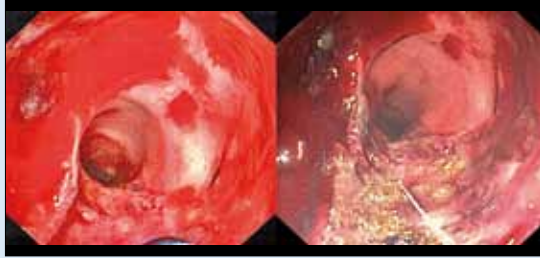


Figure 27: Needle-free, waterjet technique for layer-specific elevation of the mucosa

Figure 28: Use of the HybridKnife for elevation prior to resection during an ESD procedure: 4 steps, 1 instrument

Figure 29:  
Using APC to achieve hemostasis



### Coagulation for hemorrhages

Using argon plasma coagulation in the gastrointestinal tract is especially suitable for chronic or acute capillary bleeding and for bleeding caused by the removal of biopsy material. Diffuse bleeding covering a large area requires surface coagulation that does not penetrate tissues deeply. Effective, highly precise hemostasis is made possible by several different APC modes and by the broad selection of probes and discharge apertures.

Figure 30:  
A case of watermelon stomach in which APC is used for coagulation over a large area



### Vascular malformations such as angiodysplasia, GAVE syndrome (watermelon stomach)

Vascular malformations can arise in any section of the gastrointestinal tract. When used at low power settings, APC provides an effective treatment for conditions such as angiodysplasia, for which low-level APC effects are sufficient.

Figure 31:  
Using APC to treat angiodysplasia



### Devitalization/recanalization of stenoses/tumor debulking

When operated in FORCED APC mode, argon plasma coagulation offers outstanding options for recanalizing endoluminal tumors. High-power vaporization is the primary APC treatment used for removing relatively large amounts of tumor tissue.

See <sup>3</sup> for more information

### APC treatment for a Zenker's diverticulum

Zenker's diverticulum is a pouch-like protrusion of the esophageal wall. Endoscopic argon plasma coagulation is frequently used to treat this dysfunction of the upper esophageal sphincter by feeding an APC probe through an endoscope and (partially or completely) cutting through the connecting muscle between the esophagus and the diverticulum. Compared to other methods, minimally invasive APC technology has the advantages of more efficient hemostasis and the ability to apply the HF current without contacting the tissue.

In addition to APC, conventional electro-surgery with a needle knife and ENDO CUT Q are also used to bisect the connecting muscle in a Zenker's diverticulum include.

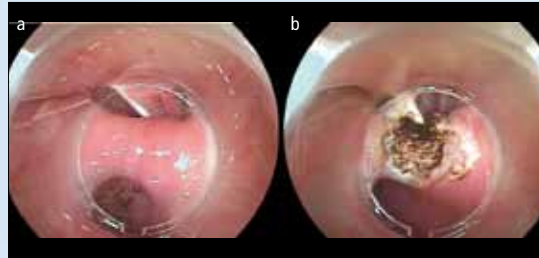


Figure 32: Zenker's diverticulum before (a) and after treatment (b) with APC (with cap)

### APC and stents

Compared to other methods such as laser surgery, APC has been shown to be an extraordinarily effective means of removing tumor tissue (proliferation). The technology can prevent unintended destruction of a stent, even when operated at a comparable power setting.



Figure 33: Application of APC for stent ingrowth/overgrowth

### APC in the tracheobronchial tract








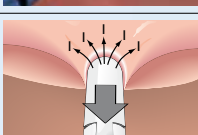
A low concentration of oxygen should be used during insufflation when performing thermal techniques such as APC in the tracheobronchial system for the purpose of recanalizing stenoses or staunching bleeding.



Figure 34: Recanalization of a stenosis in the tracheobronchial tract









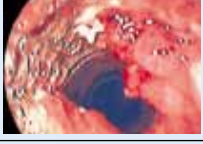

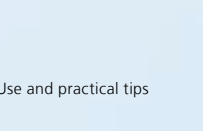
See <sup>3</sup> for more information

## MODE OVERVIEW

Mode		Mode description
	<b>DRY CUT</b>	Cutting mode with significant coagulation effects
	<b>ENDO CUT I</b>	Fractionates the cutting process into cutting and coagulation intervals Goal: Controlled papillary incision with adequate hemostasis
	<b>ENDO CUT Q</b>	Fractionates the cutting process into cutting and coagulation intervals Goal: To prevent bleeding caused by too little coagulation and perforation caused by too much
	<b>FORCED COAG</b>	Fast and effective standard coagulation; heat penetrates to a medium depth; little carbonization
	<b>FORCED APC</b>	Transfers considerable energy to the target tissue for deep coagulation of pronounced bleeding; penetration depth depends on the distance to the probe.
	<b>PRECISE APC</b>	Relatively low energy transfer for precisely adjustable coagulation effects; penetration depth remains constant if the distance to the probe is 5 mm or less.
	<b>PULSED APC</b>	Pulsed and, as such, readily adjustable energy transfer for static and dynamic APC applications
	<b>SOFT COAG</b> <b>BIPOLAR SOFT COAG</b>	Gentle, deep coagulation with no carbonization; minimal adhesion between the electrode and coagulated tissue

Instrument	Application in the gastrointestinal tract (GIT)
HybridKnife Needle electrode	Polypectomy Endoscopic submucosal dissection (ESD) Endoscopic mucosal resection (EMR)
Sphincterotome	Papillotomy Precut maneuver
Polypectomy snare	Polypectomy Endoscopic submucosal dissection (ESD) Endoscopic mucosal resection (EMR)
HybridKnife	Marking a lesion prior to ESD Post-operative coagulation of an ESD resection bed
APC probe	Tumor debulking Coagulation of extensive, malignant stenoses Coagulation of acute ulcerous hemorrhages and pronounced bleeding
APC probe	Coagulation of angiodysplasia in thin-walled structures (ascending colon, small intestine)
APC probe	Coagulation of diffuse bleeding covering relatively large areas (e.g., angiodysplasia); small, superficial lesions in thin-walled structures; for static applications: tumor debulking
Flexible, monopolar grasping forceps	Coagulation for small hemorrhages or small polyps

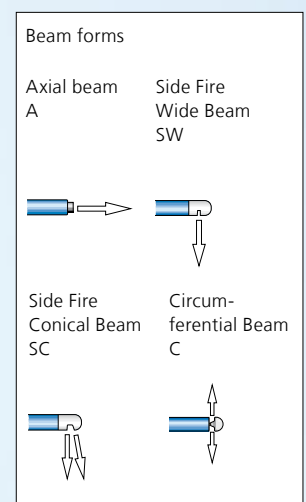
## APPLICATION OVERVIEW

Application	Instrument
 Polypectomy	Polypectomy snare
	Papillotomy
	Papillotome Precut papillotome/needle papillotome
	EMR
	Flexible waterjet probe
	HF snare, needle instrument APC probe HF snare Needle instrument
	ESD
	HybridKnife (Type I, Type T)  APC probe HybridKnife
	Hemostasis
	Vascular malformations: Watermelon stomach (GAVE syndrome)
	Angiodysplasia
	Devitalization Recanalization of stenoses Tumor debulking
	APC probe, Ø 2,3 mm, Type A/S
	Zenker's diverticulum
	APC probe, Ø 2,3 mm, Type A/C Needle Knife
	Stent ingrowth/overgrowth
	APC probe
	Stent trimming
	Trachea, bronchial system Tumor debulking (trachea, bronchi)
	APC probe
	Bleeding
	APC probe

Recommended settings	
<b>Resection of polyps:</b> ENDO CUT Q, effect 1–2 for stalked polyps < 5 mm ENDO CUT Q, effect 3 for stalked polyps > 5 mm ENDO CUT Q, effect 4 for stalked polyps > 15 mm Cutting duration 1, cutting interval 6	<b>Pre-coagulation/resection of polyps &gt; 10 mm:</b> FORCED COAG, effect 2, 60 Watts
<b>Papillotome:</b> ENDO CUT I, effect 2 Cutting duration 3, cutting interval 3	
<b>Precut:</b> ENDO CUT I, effect 1 Cutting duration 3, cutting interval 3	
<b>Mucosa elevation, see ESD (below)</b>	
<b>Marking a lesion:</b> FORCED COAG, effect 2, 60 Watts PULSED APC, effect 1, 25 Watts	
<b>Resection:</b> ENDO CUT Q, effect 3 ENDO CUT Q, effect 2	
<b>Mucosa elevation</b> <b>Esophagus/stomach:</b> Effect 30–50	<b>Coagulation:</b> FORCED COAG, effect 2, 60 Watts
<b>Ascending colon:</b> <b>Descending colon/rectum:</b> Effect 10–15              Effect 20–30	<b>Incision/dissection:</b> ENDO CUT Q, effect 2–3 Cutting duration 3, cutting interval 3 DRY CUT, effect 2, 60 Watts
<b>Marking:</b> PULSED APC, 20 Watts FORCED COAG, effect 1, 20 Watts	
<b>Ascending colon:</b> PULSED APC, effect 2, 5–10 Watts	<b>Remaining colon/rectum:</b> PULSED APC, effect 1–2, 20 Watts
PULSED APC, effect 1–2, 10–40 Watts	
PRECISE APC, effect 3	
FORCED APC, effect 2, 30–50 Watts	
PULSED APC, effect 1, 40–50 Watts	
PULSED APC, effect 2, 20–30 Watts	
FORCED APC, 30–60 Watts	
FORCED APC, 30–50 Watts	
PULSED APC, effect 2, 10–25 Watts	

- CUT
- COAG
- waterjet

Figure 35: Direction of the flow of argon gas (arrows) for various probe apertures; plasma and tissue effects of the A, S and C probes.



For detailed information on recommended settings, please see the back side of individual brochures

# SAFETY INFORMATION FOR APPLYING ELECTROSURGERY AND APC

When used properly, electrosurgery poses virtually no risk to the patient or to operating personnel. The purpose of this checklist is to make the user aware of risks in order to eliminate them.

## General notes

- ❑ Familiarize yourself with system features and with how to operate the system properly before using it (see Germany's Medical Devices Operator Ordinance, or MPBetreibV). In addition to its instructions for use, ERBE also offers training and accompanying literature.
- ❑ Because the electrosurgery unit, instruments and accessories are designed to work together, use either recommended accessories or equipment that has been obtained from a single manufacturer in as complete a form as possible. See ERBE instructions for use for additional information.
- ❑ Inspect the electrosurgery unit, instrument and accessories before use to ensure that they are in proper working condition and free of damage.

## Patient positioning

- ❑ The patient must be dry and insulated. OR table overlays or cloth covers that have become wet should be replaced during surgery.
- ❑ Place a urinary catheter in the patient for relatively long operations.
- ❑ The patient must not touch any electrically conducting objects such as drip stands or the metal parts of the OR table.
- ❑ Avoid skin-to-skin contact points with the patient (e.g., hand/thigh).
- ❑ Do not install connecting cables on top of other cables or in places where they represent tripping hazards.
- ❑ Place instruments on the instrument table and not on or next to the patient.
- ❑ A note on disinfectants: because electrical sparks can ignite the alcohol in these agents, disinfectants must always be dried off completely.

## Other recommendations

### Pregnancy

- ❑ While no adverse incidents are known, we nevertheless recommend using bipolar electrosurgery.

### Operations on patients with artificial pacemakers

- ❑ Follow the pacemaker manufacturer's recommendations.
- ❑ Avoid allowing current to flow across the pacemaker, probe or cardiac muscle.
- ❑ The patient plate should be positioned as close as possible to the operating field but at least 15 cm from the pacemaker.
- ❑ Bipolar application is preferable to monopolar application.
- ❑ Select low settings.
- ❑ If possible, deactivate the pacemaker or ICD before applying HF current.
- ❑ Monitor the pacemaker before, during and after surgery for any potential malfunction.
- ❑ Brief activation bursts should be avoided. The artificial pacemaker could interpret these as cardiac arrhythmia and generate stimulus signals as a result.

## **Important rules for using APC**

### **Increased efficiency of the VIO generation**

- ❑ The effect produced by VIO APC 2 is 50% higher than that of ICC technology and APC 300, even when the wattage is the same. As such, APC 2 power settings (via the VIO display) should be lower than those of APC 300.

### **The APC probe must always be in the gastroenterologist's field of vision.**

- ❑ The APC probe should always protrude from the endoscope by at least 10 – 15 mm to prevent damage to the tip of the endoscope and to the instrument channel. During dynamic application, always move the APC probe back and forth together with the entire endoscope – never move the probe by itself.

### **Work must only be performed where there is adequate visibility.**

- ❑ APC activation should always be performed where there is adequate visibility. Only gastroenterologists with sufficient practice and experience should attempt to activate the plasma beam from "around the corner" (around a fold, for instance).

### **Note the penetration depth and dosage.**

- ❑ The penetration depth selected for APC thermal effects depends on a number of different factors. The dosage should be applied with special care when working with thin-walled structures, especially the ascending colon.

### **Avoid tissue contact**

- ❑ The tip of the APC probe should not be pressed into the mucous membranes during application, as the argon gas emitted could cause swelling. Direct contact between the probe and tissue carries risks ranging from contact coagulation to perforation.

### **Avoid proximity to metal objects**

- ❑ Metal clips must not be nearby when the APC probe is activated, as this could result in sparks and thus unintentional tissue coagulation.

## Recommendations for positioning the patient plate for monopolar electrosurgery

Given today's state-of-the-art technology, the risks incurred during monopolar electrosurgery are very low. The use of the patient plate does, however, give rise to questions and issues that we would like to clarify in this section.

In addition to carefully positioning the patient plate and ensuring contact across its entire surface, we also recommend working through the following safety checklist:

- ❑ Check cables and plugs for any damage.
- ❑ Do not cut the patient plate.
- ❑ Position the patient plate with the long edge facing the operating field.
- ❑ The area of application should be dry and smooth with no disinfectant, and should not be in contact with body hair, skin folds or lesions.
- ❑ Avoid air pockets between the skin and patient plate; do not use contact gel.
- ❑ Do not place the patient plate on scarred or inflamed areas of skin, on bony structures or near metallic implants that should not lie in the flow of current.
- ❑ Conductive muscular tissue with low electrical resistance is preferable to areas with subcutaneous fatty tissue. We recommend the upper arm or thigh.
- ❑ Position the patient plate in such a way that EKG cables and electrodes do not lie in the flow of current.
- ❑ If the patient is repositioned, recheck the electrode and all connections to make sure they are positioned correctly.
- ❑ The NESSY patient plate is not designed to be reused and should be replaced each time it is removed (e.g., when correcting its positioning).
- ❑ Position the patient plate as close to the operating field as possible.
- ❑ When positioning the patient plate, implants must be taken into consideration and must not lie in the flow of current.

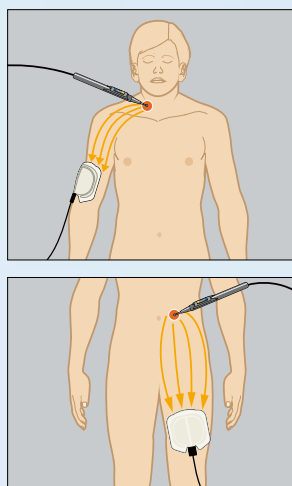


Figure 36:  
Position the patient plate as close to the operating field as possible.

### General recommendations:

- ❑ Arc flashes may occur during monopolar electrosurgery if the user activates uninsulated forceps using a single-pole electrode (improper use!). Because their use is not uncommon in actual practice, we recommend using insulated forceps.
- ❑ EKG interference caused by electrosurgery can be avoided by using monitor-filter systems or accessories compatible with HF equipment.

### Application in children

- ❑ The patient plate can also be placed on the patient's torso if the upper arm and thigh are too thin.
- ❑ The patient plate should generally be placed on the torso when working with infants. Whenever possible, work only with low HF power (below 50 W).
- ❑ Patient plates for children should only be used when a larger patient plate cannot be positioned correctly. The larger the patient plate, the less skin warming.

### Operations on patients wearing jewelry (piercing, necklace, ring, etc.)

- ❑ We recommend always removing the jewelry (piercing, necklace, ring, etc.)
- ❑ Performing electrosurgery on patients with piercings that cannot be removed is not contraindicated, provided the following rules are observed:
- ❑ Jewelry must not come in direct contact with the active electrode or patient plate.
- ❑ Neither the active electrode nor the patient plate may be used in the direct vicinity of piercings.
- ❑ The piercing must not be located in the flow of current between the active electrode and patient plate.
- ❑ Jewelry must not come in contact with electrically conducting materials.

### Following surgery...

- ❑ Carefully peel the patient plate off the skin to prevent injury.

# GLOSSARY

**Active electrode** The part of the electro-surgical instrument that transmits the electro-surgical current at the site of the intended tissue effect to the patient's tissue; acronym: AE

**Argon plasma coagulation** Monopolar, non-contact coagulation. Electrically conductive argon (argon plasma) transmits the current to the tissue through electric arcs. Acronym: APC

**Bipolar electro-surgery** Electro-surgical procedure in which both electrodes are integrated in an instrument

**Burns due to patient plate** Burning of the skin due to excessively high heat generation through excessive current density under or at the patient plate

**Carbonization** Carbonization of biological tissue

**Coagulation** 1. Denaturation of proteins. 2. Electro-surgical effect during which proteins coagulate and the tissue shrinks

**Current density** Current flow amount per cross-section area. The higher the current density, the more heat is generated

**Cutting** Electro-surgical effect during which the intracellular fluid is explosively vaporized and the cell walls burst

**Desiccation** Drying out of biological tissue

**Devitalization** Killing off of biological tissue

**Diathermy** Synonym for electro-surgery

**Electric arc** Electrical discharge in the form of a very small flash

**Electrode** Conductor that transmits or receives current, e.g. active electrode, patient plate

**Electro-surgery** Use of high-frequency electric current on biological tissue with the goal of creating a surgical effect through heating. Synonyms: HF surgery, diathermy, radio frequency (RF) surgery

**Frequency** Rate of periods per second during which the current direction changes twice, for example. Unit: hertz (Hz). 1 kHz = 1,000 Hz

**Hemostasis** Stopping of blood flow

**High frequency** In terms of electro-surgery (standard: IEC 60601-2-2): frequency of at least 200 kHz. Acronym: HF; also radio frequency (RF)

**High-frequency generator** Device or device component that converts direct current or low-frequency alternating current into high-frequency surgical current

**Incision quality** The nature of the incision, especially the extent of the coagulation at the incision margin. The desired incision quality depends on the application

**Lesion** Damage, injury or disruption to an anatomical structure or physiological function

**Monopolar electro-surgery** Electro-surgical procedure during which the active electrode is used at the surgical site and the electrical circuit is closed by a patient plate

**Necrosis** Pathological cell death

**Patient plate** Conductive electrode which is attached to the patient during a monopolar application in order to receive the HF current. It feeds the current back to the electro-surgical unit in order to close the electrical circuit. Synonyms: neutral electrode, return electrode

**Power** Energy per second. The electrical power is the product of current and voltage. Unit: watt (W)

**Thermofusion** Fusion of tissue through coagulation

**Vaporization** Vaporization of tissue

**Additional reference materials**

- 1 Principles of Electrosurgery, No. 85800-103
- 2 Application brochure of Electrosurgery, No. 85800-127
- 3 APC application brochure, No. 85800-121
- 4 Polypectomy application brochure, No. 85800-117
- 5 Papillotomy application brochure, No. 85800-119
- 6 ESD application brochure, No. 85800-123
- 7 NESSY  $\Omega$  application brochure, No. 85800-107
- 8 HybridKnife leaflet, No. 85100-158
- 9 FIAPC probes leaflet, No. 85100-140
- 10 VIO product family leaflet, No. 85140-190
- 11 Information folder for Gastroenterology, No. 85810-126

**Additional information:**

European Society of Gastrointestinal Endoscopy (ESGE) guideline:  
The use of electrosurgical units

Up-to-date product and application information may be found at  
[www.erbe-med.com](http://www.erbe-med.com) in publications such as our accessories catalog.

**User Hotline:**

**Phone +49 7071 755-123**

**Fax +49 7071 755-5123**

**[support@erbe-med.com](mailto:support@erbe-med.com)**

**ERBE Elektromedizin GmbH**

**Waldhoernlestrasse 17**

**72072 Tuebingen**

**Germany**

**Phone +49 7071 755-0**

**Fax +49 7071 755-179**

**[info@erbe-med.com](mailto:info@erbe-med.com)**

**[www.erbe-med.com](http://www.erbe-med.com)**



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