

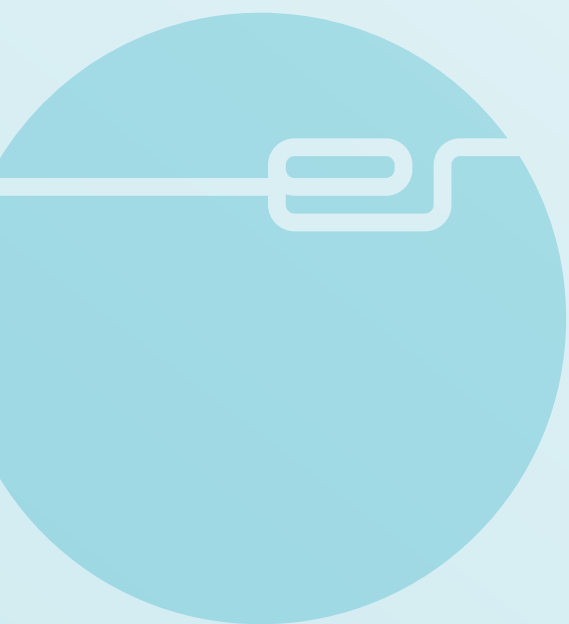


Gastroenterology

Use
and practical tips

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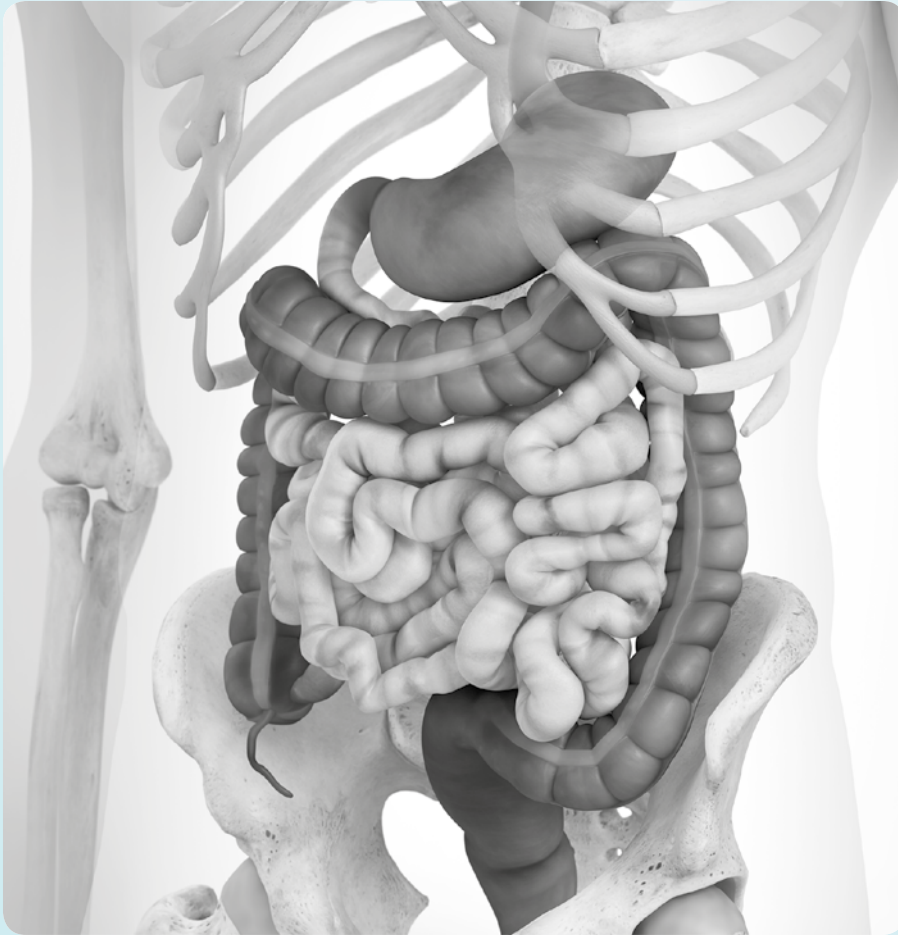
Important information

While Erbe Elektromedizin GmbH has taken the greatest possible care in preparing this brochure and compiling the 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 the information on recommended settings, application sites, duration of application and the use of instruments is based on clinical experience, individual centers and physicians also favor settings other than those recommended here. This information is intended only as a guideline and must be evaluated by the surgeon for applicability. Depending on individual circumstances, it may be necessary to deviate from the information provided in this brochure.

Medicine is constantly subject to new developments based on research and clinical experience.

This is another reason why departing from the information provided here may be appropriate.



Arrangement of the structures in the upper gastrointestinal tract (esophagus, stomach and duodenum) and lower gastrointestinal tract (jejunum, ileum, cecum, colon, sigmoid and rectum)

Endoscopic applications of electrosurgery

Electrosurgery, or HF surgery, plays an important role in interventional endoscopy. Diseases in the gastrointestinal tract are treated with electrosurgical cutting, coagulation and devitalization^{1,2}. In particular, argon plasma coagulation (APC), a special form of electrosurgery, has become established as a standard technique in many areas of applications over recent decades since the development of flexible probes. APC have proven to be a safe, effective and yet cost-efficient technique as compared to laser treatment, for example. Electrosurgery utilizes thermal effects whose impact on the targeted tissue differs dependent upon the temperature.

Waterjet technology is of growing importance in gastroenterology. The water jet separates and lifts tissue layers, so lesions can be safely resected while tissue is protected against thermal impact.

Gastroenterology workstation

The gastroenterology workstation offers a broad spectrum of electrosurgical applications in endoscopy. In the fully equipped version (Fig. 1) it consists of the electrosurgical unit (VIO 200 D), units for argon plasma coagulation (APC 2) and waterjet surgery (ERBEJET 2), as well as an endoscopy irrigation pump (EIP 2) used to flush the target region and thus improve visibility.

The workstation's software, hardware, unit modules and the wide range of instruments are configured for flexible endoscopy. The functions of the individual modules are described in the chapters on cutting and coagulation modes (starting on page 14) and on applications (starting on page 20).

Electrosurgery allows for cutting with minimal application of force, as well as effective coagulation and devitalization of the target tissue in the gastrointestinal tract. Argon plasma coagulation, a special form of electrosurgery, homogeneously staunches bleeding and devitalizes tissue lesions without any direct contact between the instrument and tissue.

The waterjet function separates layers, lifts them apart and forms a thermal protective cushion. The HybridKnife and HybridAPC, both combination instruments, integrate these functions in one instrument and can be used alternately at any time.

01 VIO® 200 D

02 APC 2

03 ERBEJET® 2

04 EIP 2



Fig. 1: Gastroenterology workstation:
with units for electrosurgery, argon plasma coagulation,
waterjet surgery and endoscopic irrigation

Effects of the technologies

Electrosurgery



Endoscopic cutting used to perform papillotomies, for example



A tissue lesion is marked with coagulation points, and bleeding is staunched using coagulation current



Example for the use of APC for tumor devitalization

CUTTING

01

Voltages of 200 V or more produce sparks between the electrode and the tissue. For cutting modes, temperatures of 100°C and higher are generated by electrical energy. Intracellular and extracellular fluids vaporize so quickly that the cell membranes and cell layers rupture and the tissue is cut as a result.

COAGULATION

02

Coagulation current is used to staunch bleedings. Conversion of electrical energy into heat generates temperatures between 60°C and 100°C. The tissue dries and shrinks due to fluid vaporization. Tissue lesions can be marked with coagulation points.

DEVITALIZATION

03

This technique is used to target specific tumors and destroy them. Cell damage becomes irreversible at temperatures between 50 and 60°C.

Waterjet surgery

THERMAL EFFECTS ON BIOLOGICAL TISSUE

37-40°C

None

From ~ 40°C

Hyperthermia:

initial tissue damage, edema formation, depending on the duration of application, the tissue can recover or die (devitalization)

From ~ 60°C

Devitalization (destruction)

of the cells, shrinkage of the connective tissue through denaturation

~ 100°C

Vaporization of the tissue fluid, depending on the speed of vaporization:

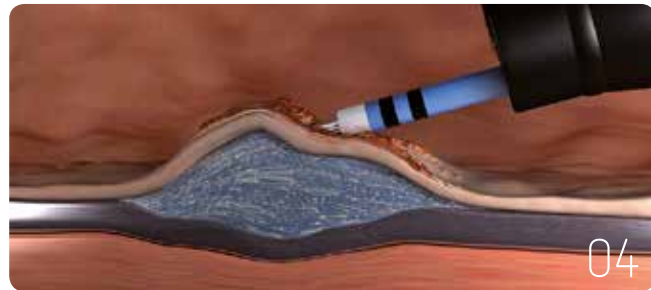
- Tissue shrinkage through desiccation (drying out) or
- Cutting due to mechanical tearing of the tissue

From ~ 150°C

Carbonization

From ~ 300°C

Vaporization (evaporation) of the entire tissue

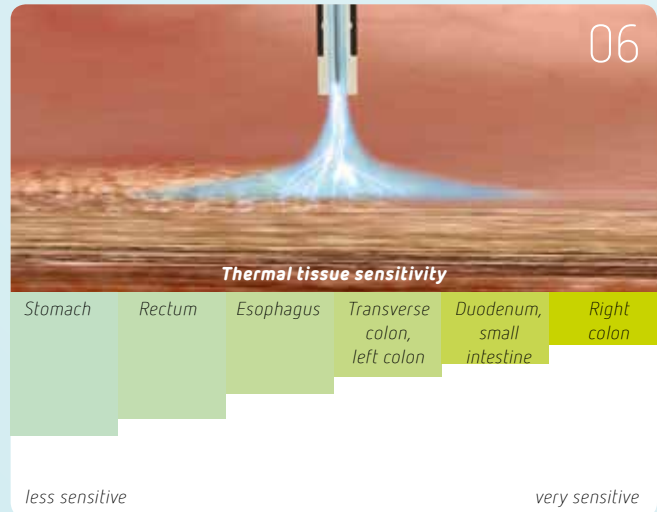
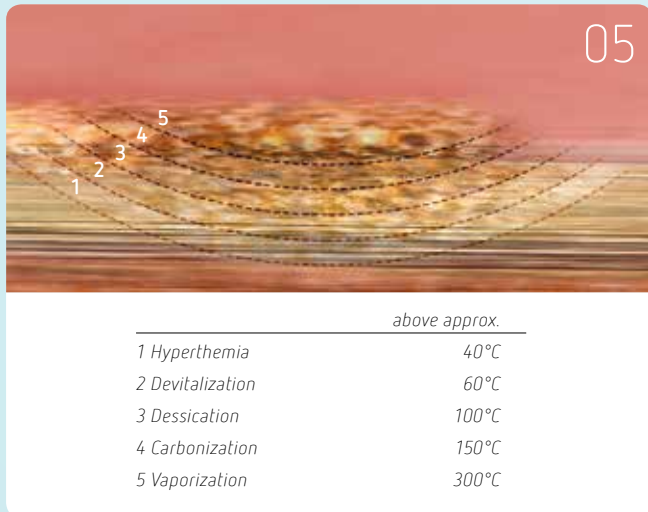


Elevation of the mucosa during ESD

ELEVATION AND SEPARATION USING THE WATERJET 04

Needleless waterjet elevation can be used to create fluid cushions in the tissue. Anatomical layers can be separated from one another as well.

Argon plasma coagulation



Tissue effects

In argon plasma coagulation the target tissue is heated using monopolar current flow. Dependent on three influencing factors, the following thermal effect zones arise and spread into deeper tissue layers (Fig. 05):

1. Hyperthermia
2. Devitalization
3. Coagulation
4. Dessication
5. Carbonization
6. Vaporization

Factors influencing the tissue effect

The following main factors have an influence on the coagulation depth. They are listed in order of relevance:

1. Application duration (especially in cases of static application)
2. Power output (effect level)
3. Distance between probe and target tissue

APPLICATION DURATION – THE KEY FACTOR

The longer the APC is applied, the deeper the effect on the target tissue will be.

For this reason, we recommend starting with short activation times and increasing the duration step by step up until the desired effect is reached (e.g. PULSED APC, Effect 1). This holds in particular for APC applications involving thin-walled structures, such as in the right colon, and for children in general.

DIFFERENCES IN THERMAL SENSITIVITY

06

The structures in the gastrointestinal tract differ in sensitivity. This must be taken into account when selecting power output and application duration for electrosurgical interventions, particularly those involving APC.

POWER/EFFECT SETTING

Power output should be set dependent on localization and size (diameter, depth, elevation) and the lesion being treated. Low power settings are suitable for superficial, small lesions and for application in thin-walled tissue structures, such as the right colon or the duodenum. Medium power settings are ideal for devitalizing or reducing tumors and for staunching bleeding. High power settings are especially used for palliative tumor treatment, e.g. for tumor devitalization of larger exophytic tumors and for recanalization of stenoses.

PROBE DISTANCE

Increasing the distance between the probe and tissue will result in a decrease in the tissue effect produced by PULSED APC and FORCED APC, with ignition ultimately disappearing.

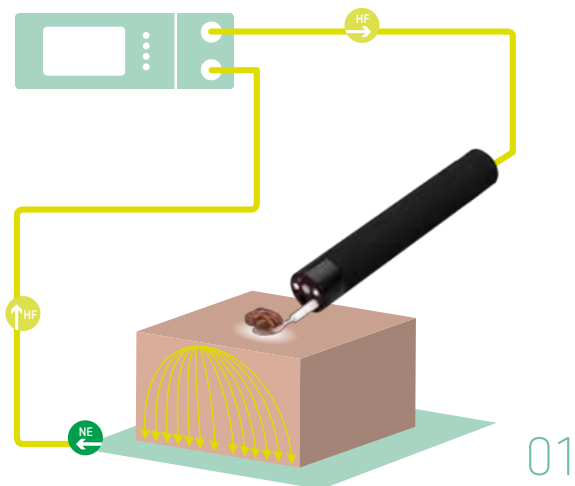
The PRECISE APC mode is an exception: As a result of the plasma regulation, the tissue effect remains constant up to a distance of 5 mm. This can be advantageous, for example in cases of pronounced intestinal peristalsis.

STATIC AND DYNAMIC APPLICATION

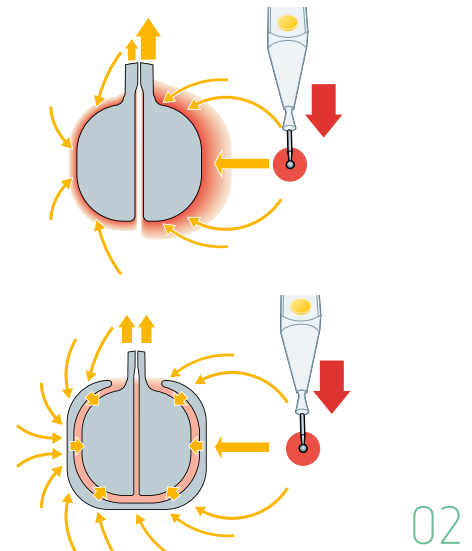
Static APC application for long durations increases, the depth effect considerably. If the application time is too long, this can lead to carbonization and perforation of the tissue. Thus for static application involving superficial lesions, we recommend short application times of 1 to 2 seconds.

For dynamic application, the APC probe should be moved across the target tissue using slow, controlled movements (brushstrokes) under visual control.

Techniques: Electrosurgery



Circuit for monopolar electrosurgery



↑ High current density on the side closest to the operating field in the case of an incorrectly positioned conventional patient plate

↓ Distribution of current with no partial heat generation in case of NESSY Ω, which can be positioned independent of direction

MONOPOLAR TECHNIQUE

01

In monopolar electrosurgery, high-frequency current flows in a closed loop: from the unit to the instrument, then through the patient's body to the patient plate (PP), and from there back to the unit. The surgical effect is produced at the tip of the active electrode. Due to its relatively small contact surface, this is where the highest current density is reached. The second electrode, the patient plate, is placed on the patient's skin in a location which allows for conduction of the current over a large surface area.

At the site of localized application, the high current density produces a thermal effect such as an incision or coagulation. Due to the low current density, generation of heat on the large surface of the patient plate poses no problem.

Safety factors pertaining to monopolar electrosurgery and endoscopy

Both components – the NESSY patient plate safety system of the Erbe VIO and the Erbe NESSY Ω patient plate - reduce the safety risks connected with monopolar electrosurgery in gastroenterology.

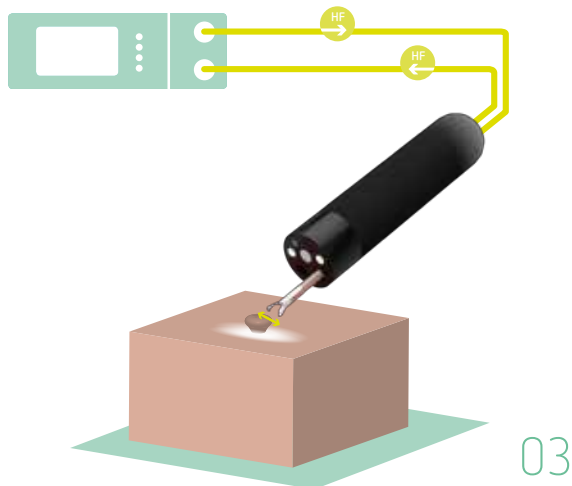
NESSY verifies whether the two-part patient plate has been positioned correctly and whether its entire surface is in contact with the patient, and it continuously compares the currents of both patient plate surfaces.

In cases of slight deviation, activation is possible. In cases of significant deviance, activation is interrupted with a warning signal. To prevent burns, reactivation of the electrosurgical current is not possible until the patient plate has been correctly positioned.

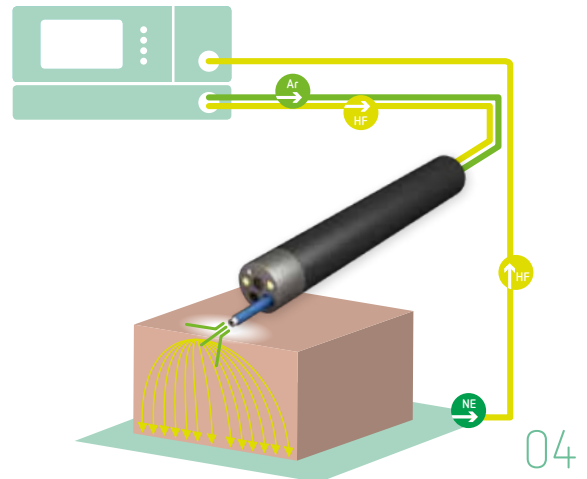
Simple and safe application with NESSY Ω

The NESSY Ω patient plate is equipped with a non-contact ring surface that surrounds the actual electrode surface. This equipotential ring distributes the current evenly across the inner contact surfaces and prevents the patient plate from only heating up on one side (leading-edge effect). As a result, it can be positioned in any direction. Compared with conventional patient plates, Nessy Ω (Fig. 2[↑] and 2[↓]) is easier to position; this enhances safety. The NESSY Ω is smaller than conventional electrodes, which makes it easier to attach to the patient's body. It is universally suitable for children and adults alike.

We therefore recommend using NESSY Ω to achieve maximum safety in monopolar electrosurgery.



Circuit for bipolar electrocautery



Circuit for the monopolar APC technique

BIPOLAR TECHNIQUE

03

The bipolar technique offers the advantage of being able to limit the flow of current to the target area between the poles. Unlike monopolar electrocautery, this technique prevents sensitive structures such as nerves that lie in the path of the current flow between the operating field and patient plate from incurring thermal damage inadvertently.

Bipolar electrocautery instruments such as coagulation forceps have two integrated active electrodes. Current only flows through the tissue between the two poles of the branch and not through the patient's body. The bipolar technique does not require the use of a patient plate.

ARGON PLASMA COAGULATION (APC)

04

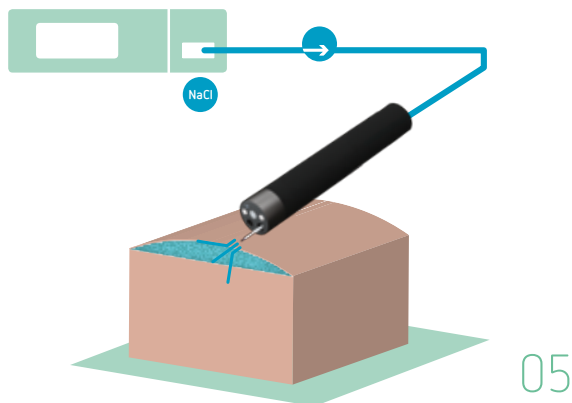
In APC, ionized argon gas conducts the electrocautery current to the target tissue without contact between the probe tip and target tissue.

The procedure has few complications, staunches bleeding reliably, and facilitates effective and homogeneous surface coagulation and devitalization with adjustable penetration depth. Because it is a non-contact method, one advantage of APC is that the distal end of the instrument cannot adhere to the coagulated tissue and tear open the sloughing. Another advantage which is relevant for endoscopic use is the limited penetration depth of APC, which minimizes perforation.

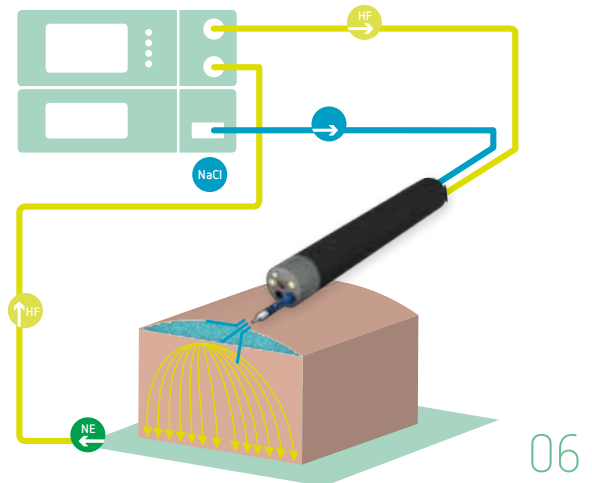
The plasma stream and the tissue effect are determined by the type of probe, which defines the direction of application. APC can be applied axially and tangentially. The tissue effect is also influenced by the duration of the APC application and the APC mode.

Techniques:

Waterjet surgery



The principle of waterjet surgery as illustrated by the flexible waterjet probe



The principle of waterjet surgery with combined monopolar circuit using the HybridKnife

WATERJET ELEVATION

05

The finely adjustable waterjet allows tissue types of various strength and elasticity to be separated. The expansion effect of the water jet is used to form fluid cushions, lifting tissue layers.

In gastroenterology, for example, the flexible waterjet probe is used to elevate tumor-bearing mucosa layers which are then resected using the snare technique.

WATERJET ELEVATION WITH ELECTROSURGERY OR WITH APC

06

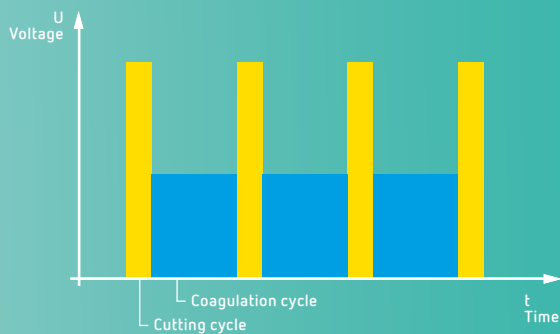
The HybridKnife probe integrates the waterjet and electrosurgery functions. Prior to resection of tumors in the gastrointestinal tract, a fluid cushion is created in the submucosa to elevate the mucosa at the site of the lesion. Subsequent electrosurgical cutting using the HybridKnife can thus be performed at a defined and higher resection level. Elevation thus reduces the risk of perforation.

The HybridAPC probe employs the same principle of combining waterjet elevation with argon plasma coagulation.

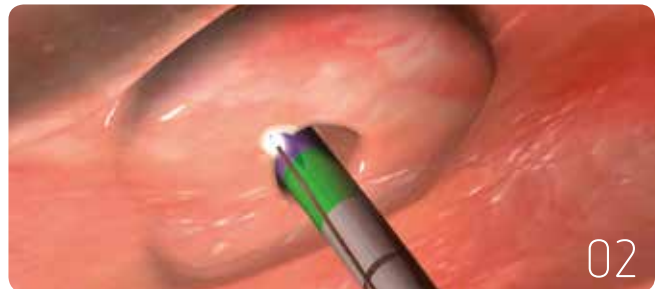


Cutting and coagulation modes

Fractioning of the process into cutting and coagulation intervals is performed automatically by the ENDO CUT mode. For the user this means: yellow pedal remains pressed (permanently activated); the rest is taken care of with ENDO CUT.



Endoscopic polypectomy using ENDO CUT Q



Endoscopic papillotomy using ENDO CUT I

ENDO CUT® Q

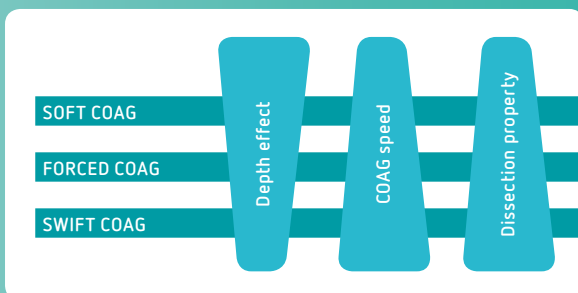
01

ENDO CUT Q fractionates the cutting process into controlled cutting and coagulation intervals, e.g. for endoscopic polypectomy using a snare and for EMR or ESD using the HybridKnife. Cutting and coagulation cycles can be adjusted individually to minimize the risks connected with polypectomies, such as bleeding if coagulation is insufficient, or perforation if coagulation is too intense.

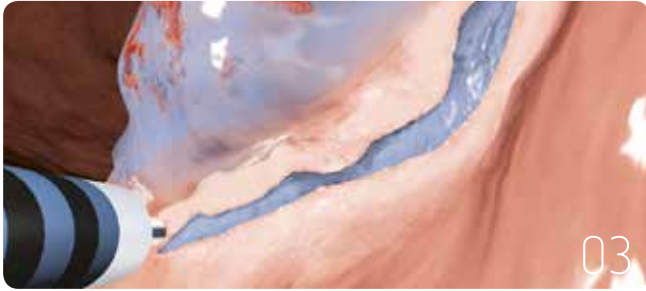
ENDO CUT® I

02

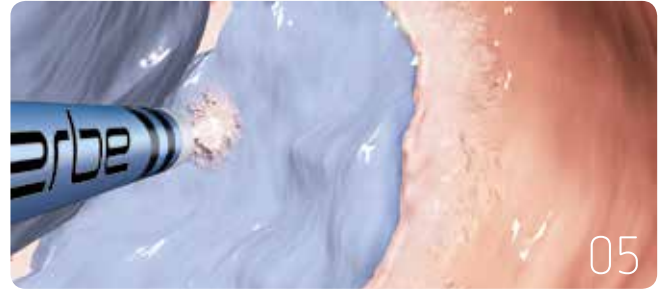
The fractionated cutting mode ENDO CUT I is used for papillotomies and other applications involving a needle or wire instruments in endoscopy. The cutting and coagulation cycles can be adjusted individually to minimize the risks connected with polypectomies and sphincterotomies, such as the zipper effect (uncontrolled incision into the papilla).



Properties of the COAG modes



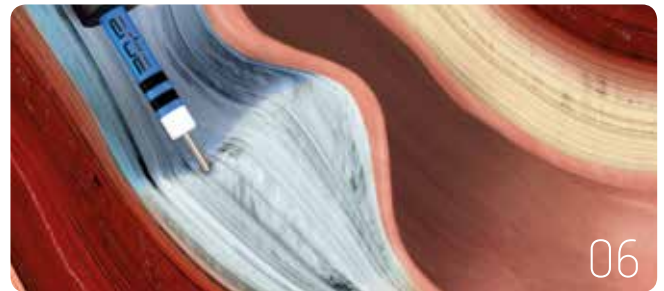
DRY CUT using ESD for a pronounced hemostasis effect



*Example of a FORCED COAG application:
Coagulation after bleeding using ESD*



Minor bleeding is coagulated with SOFT COAG



Tunneling of the submucosa with POEM using the HybridKnife

DRY CUT **03**

The DRY-CUT mode cuts using modulated current forms with pronounced hemostasis. DRY CUT is the mode which offers optimal cutting performance for initial and circular incisions and resection during endoscopic submucosa dissection.

SOFT COAG **04**

SOFT COAG is a sparing, conventional form of coagulation for deep tissue penetration. It minimizes adhesion between the electrode and the coagulated tissue. SOFT COAG is suitable for coagulating minor bleedings with a maximum application time of 1 to 2 seconds, for example.

FORCED COAG **05**

This coagulation mode provides fast, effective standard coagulation in the entire gastrointestinal tract with medium thermal penetration depth.

SWIFT COAG **06**

SWIFT COAG allows for effective and fast coagulation with pronounced hemostasis and is also suitable for dissection (such as submucosal tunneling involved in POEM and STER).

APC coagulation modes



Effective devitalization using FORCED APC



The PULSED APC mode is used for angiodysplasia in the colon



The PRECISE APC mode is used for angiodysplasia

FORCED APC 07

This mode offers effective coagulation and devitalization. The HF power is adjustable up to 120 Watt and is applied as continuous energy input. FORCED APC is used in the digestive tract for tumor resection (tumor debulking), as well as for coagulation of acute ulcer bleeding.

PULSED APC 08

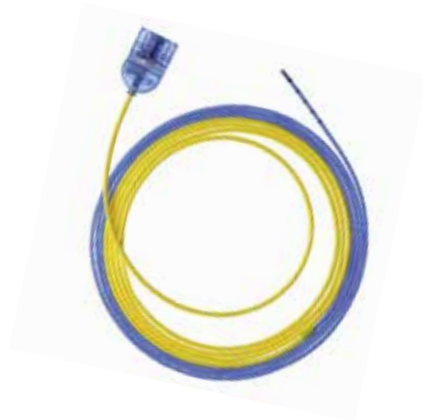
This APC mode is based on pulsed (on-off) activation. PULSED APC can be used variably to devitalize or coagulate tissue. PULSED APC is easy to regulate, the result being homogeneous tissue effects. PULSED APC allows for power inputs ranging from 1 to 120 Watts. Effect 1 produces a higher energy output per pulse with longer pulse pauses, whereas Effect 2 produces higher pulse frequency with lower energy input. The mode is suitable for hemostasis of diffuse and widespread bleeding (GAVE, angiodysplasias) and for ablation Barrett's esophagus, for example.

PRECISE APC 09

In contrast to FORCED APC, PRECISE APC works in the lower energy range. This makes it possible to produce finely dosed, uniform coagulation effects in the target tissue, regardless of the distance between the probe and the tissue. PRECISE APC is suitable for treating angiodysplasias in the right colon and the cecum, for example. This mode is also used in the small intestine for double balloon enteroscopy.



Instruments



01

In the FiAPC probes, the connecting cable and filter are completely integrated



02

Polypectomy snare



03

Papillotome

APC PROBE / FIAPC PROBE

01



Flexible APC probes are positioned at the target area of the gastrointestinal tract via an endoscope. The HF voltage ignites the chemically inert gas at the distal end of the probe and converts it into conductive argon plasma.

APC probes with different probe diameters, lengths and outlets are available for various applications in the gastrointestinal tract. They allow for non-contact tissue coagulation and devitalization.

FiAPC probes

The integrated filter protects the sterile FiAPC probe against contamination which may be caused by secretion reflux. FiAPC probes are available in different versions (lengths, diameters) with axial, lateral and circular argon gas outlets. Erbe FiAPC probes are compatible with all common flexible endoscope types.



POLYPECTOMY SNARE

02



Polypectomy snares are inserted in to the endoscope and positioned at the polyp. The snare is placed around the base of the polyp, which is then resected using the ENDO CUT Q fractioning cutting mode. Polypectomy snares are available in different shapes and designs and as single-use and reusable products. The snare consists of either a monostrand or multistrand braided wire or ribbon and its shape can be varied symmetrically or asymmetrically.

PAPILLOTOME/SPHINCTEROTOME

03

A papillotome is a flexible probe with a cutting wire at the distal end designed to split papillae in the bile or pancreatic duct. Papillotomes come in various designs. Essential differences are the length of the cutting wire (20-30 mm long), the configuration of the tip (normal or filiform) and single- or multi-lumen design.





Coagulation forceps

04



HybridKnife, complete instrument including handpiece and connecting cable

06



Flexible waterjet probe

05



HybridAPC, complete instrument including handpiece and connecting cable

07

COAGULATION FORCEPS

04



Coagulation forceps are used to stop arterial bleeding by elevating the tissue slightly from the base and coagulating it by applying monopolar or bipolar high-frequency current.



The HybridKnife is a multifunctional instrument which can be used for such procedures as Endoscopic Submucosal Dissection (ESD), Peroral Endoscopic Myotomy (POEM) and Submucosal Tunneling and Endoscopic Resection (STER). The integrated electrosurgery function and waterjet function are always available. All 4 steps required for ESD - marking, elevation, incision/dissection and coagulation - can be performed without a change of instrument.

FLEXIBLE PROBE (WATER JET)

05

The flexible probe allows for needleless elevation of the mucosa. The irrigation fluid forms a cushion in the submucosa that can be replenished as required. This prepares the lesion for subsequent EMR with optimal protection against perforation.

HYBRIDAPC

07

The HybridAPC, like the HybridKnife, is a waterjet assisted probe. Waterjet elevation is carried out prior to APC ablation. The HybridAPC is suitable for treating Barrett's Esophagus.



Electrosurgical applications



Safe removal of polyps using the ENDO CUT Q cutting mode



Layer-specific elevation of the mucosa using needleless waterjet elevation

POLYPECTOMY

01

Polyps with a diameter of up to 20 mm are removed using a polypectomy snare when availability of the required snare size and the clinical situation allow for this. The ENDO CUT Q fractionated cutting mode is ideally suited for removing tumors in the gastrointestinal tract using such procedures as polypectomy and mucosa resection.

The alternating cutting and coagulation intervals can be adapted to the gastroenterologist's working style, the shape of the polyp or lesion and the polyp snare. Controlled cutting performance with reliable hemostatic results are ensured during the entire sequence following the principle: as much coagulation as necessary (bleeding prophylaxis), as little as possible (perforation prophylaxis).

PAPILLOTOMY

Papillotomies are performed to treat choledocholithiasis and bile tract stenoses. In a papillotomy, the papillary orifice of the bile duct (where the duct drains into the duodenum) is split over a length of 1 to 2 centimeters electrosurgically.

Bile duct stones can be removed endoscopically through this papillary orifice, for example. The ENDO CUT I mode, which fractionates the cutting sequence into cutting and coagulation intervals, prevents uncontrolled incisions, the undesired zipper effect. Dependent on the form of the instrument, the surgical site and the gastroenterologist's working style, the intervals can be individually optimized.

ENDOSCOPIC MUCOSAL RESECTION (EMR)

02

EMR is an endoscopic procedure for resecting sessile or flat lesions that are limited to the mucosa and submucosa. EMR is usually carried out in combination with supportive techniques, such as elevation or suction⁵.

When high pressure elevation using the flexible waterjet probe is performed, fluid accumulates in the submucosa and forms a fluid cushion. This selective cushion, which is limited to the submucosa, creates a safety distance to the muscularis, thus minimizing the risk of perforation during snare resection. The fluid can be replenished as required.

Only lesions up to approx. 20 mm in size can be resected en bloc using the EMR snare technique – dependent on the snare size. For larger diameters, the snare must be applied several times employing a piecemeal technique.

The disadvantage of the piecemeal technique are the higher recurrence rate for some tumor types and the fact that it makes histological evaluation more difficult for the pathologist.

EFTR = ENDOSCOPIC FULL THICKNESS RESECTION

Using this method it is also possible to resect small, muscle-invasive tumors in the gastrointestinal tract endoscopically. Further indications are recurrences with non-lifting sign and polyp residues that can be resected after an incomplete polypectomy.

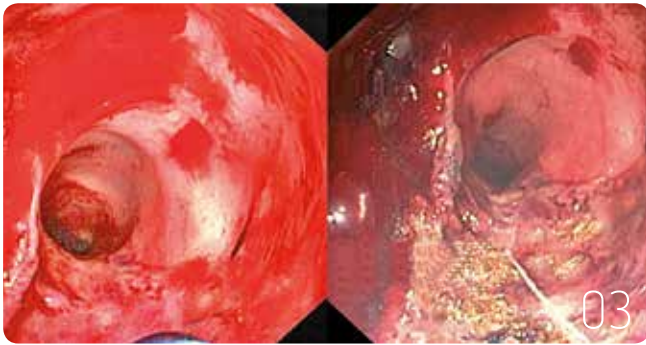
Once the tumor has been marked with the FORCED COAG mode, the cap of the resection system is placed on the lesion, held by coagulation forceps and pulled or sucked in along with the intestinal wall. Once the clip is applied, snare resection is performed using the polypectomy snare integrated in the system. ENDO CUT Q ensures reliable hemostasis of the cutting edge. The resected tissue is then removed en bloc and the resection line is visually inspected. The procedure can be repeated if corrective treatment is required.

ZENKER'S DIVERTICULOTOMY

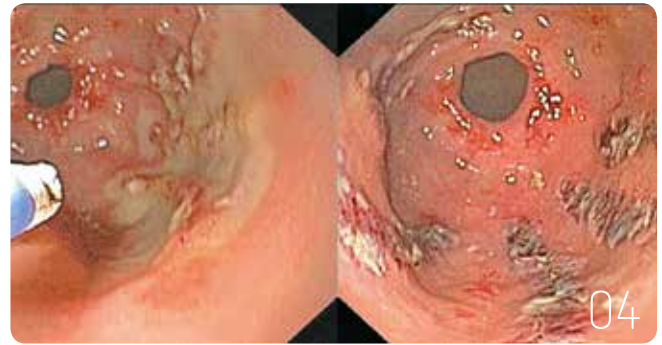
Flexible endoscopic myotomy is a minimally-invasive procedure with good success rates for treatment of Zenker's diverticulum. When performed transorally, the surgeon begins by exposing the diverticular bridge (connecting muscle) and then severing it, for example using an electro-surgical needle knife in a second session, if necessary. The incision of the septum usually extends down to the lower third of the diverticulum. Good hemostasis of the cutting edges can be achieved with ENDO CUT Q or DRY CUT.

APC (argon plasma coagulation) can also be used for severing the connective muscle, offering a suitable alternative to myotomy performed with a needle knife. Good hemostatic effects are achieved with the FORCED APC mode. Diverticulotomies performed using APC can require up to 4 sessions and are thus somewhat more time-consuming.

APC applications



Hemostasis using APC



Large-area coagulation of a watermelon stomach using APC

ACUTE BLEEDING

03

APC is one of the standard treatments for acute bloody oozing and post-biopsy bleedings in the entire gastrointestinal tract.

Acute bleeding, ulcer bleeding

APC coagulates bleeding ulcers safely and effectively using the FORCED APC mode. In case of Forrest Ib-IIa-IIb bleeding it can be combined with injection.

Diffuse bleeding

Widespread, diffuse bleeding requires coagulation over a large area. In case of mucosal fissures (Mallory-Weiss syndrome) at the gastroesophageal junction, PULSED APC is the perfect APC mode, which limits the coagulation depth to a minimum and preserves the underlying tissue layers. **APC probes with A, C and SC beam forms are all suitable for this application.**

CHRONIC BLEEDING

04

Angiodysplasia, GAVE syndrome, radioproctitis

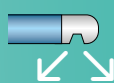
All kinds of vascular malformations in all sections of the gastrointestinal tract can be treated successfully using APC. The aim is to avoid recurrent bleeding. Depending on the indication, APC is used in combination with proton pump inhibitors and other medications. Usually a low power setting is sufficient to stop all bleeding. A low power setting is also helpful for keeping down the risk of perforation in the thin-walled parts of the intestinal tract (e.g. in the small intestine or right colon). Angiodysplasias often occur here. **APC probes with A and C beam forms are suitable for this application.**

Vascular malformations in the small intestine can be treated with excellent results using endoscopic methods, such as double balloon enteroscopy. A cap can also be used to demarcate the area under treatment in order to generate an optimal argon gas atmosphere and a safety margin. **APC probes with A and C beam shapes are suitable for performing angiodysplasias; for the double balloon technique the A beam form can be used.**

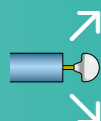
Beam forms



Axial Beam A



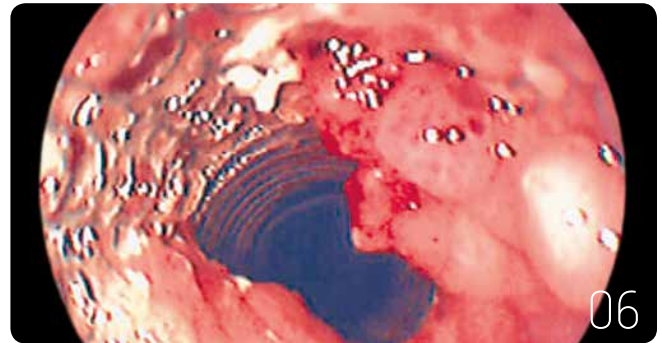
Side Fire
Conical Beam
SC



Circumferential
Beam C



Angiodysplasia with APC



APC application with stent ingrowth/overgrowth

DEVITALIZATION/RECANALIZATION OF STENOSES / TUMOR DEBULKING 05

The FORCED APC mode can be used for tumor recanalization and other indications. When removing large tumors using APC this is usually done through vaporization at very high power settings (FORCED or PULSED APC, > 60 W).

Tumor resection, recanalization of stenoses

When APC is used to reduce large tumor masses, the following effects are produced: The tissue shrinks during the APC application itself as a result of desiccation and carbonization. The necrotic tissue disintegrates in the days following the procedure. In cases of stenoses, it may be advisable to combine APC with other endoscopic methods (e.g. bougienage) to allow the passage of food in the esophagus, for instance. Due to the risk of accumulation of explosive gases, sections with filiform stenosis or blockage should be mechanically dilated first before applying APC.

Due to the advantages it offers for this application, safe and effective APC has largely replaced laser ablation in the area of flexible endoscopy. **The APC probes with A and SC beam forms are suitable for this application.**

APC AND STENTS 06

Stent implantation

The FORCED APC mode can be used to open stenoses and recanalize them over a large area to facilitate subsequent stent insertion (see Tumor recanalization).

Devitalization of stent ingrowth and overgrowth without stent damage

Tumor ingrowth in non-coated metal stents can be devitalized and removed using APC without damage to the stent. The FORCED APC mode at a medium setting or PULSED APC at a higher power setting puts little strain on the stent. **The APC probes with A and C beam forms are suitable for this application.**

Metal stent extraction

To remove the stent with ease, the tissue which has grown into the metal mesh has to be removed first, if possible 1 day before stent extraction ("two-stage" approach). The modes used for this are FORCED APC or PULSED APC (as for recanalization).

Stent shortening ("trimming")

If only partial removal of stents is desired, the protruding ends can be shortened using APC (trimming). FORCED APC mode should be set at a high power setting and applied to the trim line of the stent while being moved across its entire circumference in a non-contact fashion, so that the wire mesh heats up and melts due to the high electrical conductivity. The protruding end of the stent can then be retrieved and removed using the forceps. **(CAUTION: The PRECISE APC mode is not suitable for this application.)**

Applications using hybrid technology



*Elevation prior to resection for ESD using the HybridKnife:
4 work steps, 1 instrument*



En-bloc resection of the tumor

ENDOSCOPIC SUBMUCOSA DISSECTION (ESD) 07

The ESD technique is used in the gastrointestinal tract for en bloc resection of lesions (> 2 cm). Only histologically verified, complete resection of the lesions, so-called R0 resection, provides optimal conditions for the success of curative treatment.

The first step is to lift the mucosal lesion using the waterjet function of the HybridKnife. The separating medium accumulates in the submucosa and forms a fluid cushion as a safety buffer for the outer organ wall, the muscularis. The tissue is resected using the electrosurgery function of the HybridKnife, supported by the modes of the VIO system^{3,4}.

Both functions – water jet and electrosurgery – are available at all times in the HybridKnife combination instrument. This 2-in-1 function constitutes the essential advantage of the HybridKnife procedure for ESD. The individual steps – marking, elevation, incision/dissection and coagulation – are performed in the safest possible way without a change of instrument. All 3 HybridKnife types I, T and O are suitable for ESD, dependent on the working style and the target region.

SUBMUCOSAL TUNNELING, ENDOSCOPIC RESECTION (STER) 08

According to the principle applied for POEM, the HybridKnife is also used for STER (Submucosal Tunneling and Endoscopic Resection). Following elevation, incision and tunneling, the submucosal tumor is resected and removed en-bloc¹⁰.



POEM: Myotomy of the sphincter muscle of the esophagus using the HybridKnife



APC is suitable for both ablation of Barrett lesions as well as for small Barrett islands

PERORAL ENDOSCOPIC MYOTOMY (POEM) 09

The cause of achalasia is impairment or absence of reflexive relaxation of the lower esophageal sphincter during swallowing. This disease can be effectively treated with POEM (Peroral Endoscopic Myotomy), which involves incising the lower annular muscles⁶⁻⁹.

HybridKnife lifts up the esophagus mucosa using the waterjet function and forms a submucosal cushion. Following the incision (2 cm long, approx. 5 cm above the stenosis) the tunnel is prepared using the electrosurgery function and elevation to approx. 2 cm below the gastroesophageal junction. The mucosa is needed for subsequently covering the myotomy line and must therefore be preserved.

Using the HybridKnife, a myotomy is then performed on the sphincter muscle, beginning at around 3 cm below the site of the incision down to approximately 2 cm beneath the gastroesophageal junction. The myotomy can proceed from here towards the proximal – depending on the user's preference.

Any bleeding can be immediately coagulated using the HybridKnife. Following the myotomy, the incision is covered using the intact mucosa and the incision site is closed using clips. **HybridKnife I and T types are suitable for POEM (in certain cases: O type).**

ABLATION OF BARRETT'S ESOPHAGUS 10

For ablation of Barrett's esophagus, APC is combined with a waterjet function. Prior to ablation, the waterjet function of the HybridAPC probe lifts the mucosa. The Barrett's esophagus can now be treated at the necessary depth with higher energy input by means of the APC function with no change of instrument. Ablation takes place successively, alternating with elevation. The protective fluid cushion practically rules out damage to the muscularis or risk of strictures.

APC is applied along the Barrett structure from distal to proximal in a non-contact fashion. APC is suitable for both large Barrett lesions (up to 8–10 cm), and in particular for small Barrett's islands¹¹⁻¹⁴.

Recommended settings

Application	CUT	COAG	JET
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Polypectomy/EMR

Coecum, right colon Snare electrode	ENDO CUT Q, Effect 1 Cutting duration 1, cutting interval 6	FORCED COAG, Effect 2, 60 Watt	
Duodenum Snare electrode	ENDO CUT Q, Effect 2 Cutting duration 1, cutting interval 6	FORCED COAG, Effect 2, 60 Watt	
Esophagus, stomach Snare electrode	ENDO CUT Q, Effect 3 Cutting duration 1, cutting interval 6	FORCED COAG, Effect 2, 60 Watt	
Rectum, stalked polyps Snare electrode	ENDO CUT Q, Effect 4 Cutting duration 1, cutting interval 6	FORCED COAG, Effect 2, 60 Watt	

Papillotomy

Sphincterotome	ENDO CUT I, Effect 2, cutting duration 3, cutting interval 3	FORCED COAG, Effect 2, 60 Watt	
Needle knife	ENDO CUT I, Effect 2, cutting duration 3, cutting interval 3	FORCED COAG, Effect 2, 60 Watt	

Full thickness resection

ENDO CUT Q, Effect 1, cutting duration 4, cutting interval 1	Marking: FORCED COAG, Effect 1, 20 Watt
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Zenker's diverticulum

The APC probes with A and C beam forms	PULSED APC, Effect 1, 40-50 Watt
Electrosurgical knife/instrument	ENDO CUT Q, Effect 1, cutting duration 3, cutting interval 1

Diffuse bleeding

In the right colon / duodenum APC probes with all beam forms	PRECISE APC, Effect 4-5
In the remaining colon and rectum APC probes with all beam forms	PULSED APC, Effect 2, 10-30 Watt

Acute ulcer bleeding

Forrest Ib – IIa APC probes with all beam forms	FORCED APC, 30-60 Watt
Forrest IIb APC probes with all beam forms	FORCED APC, 20-40 Watt

Acute, non-varicose bleeding

APC probes with all beam forms	PULSED APC, Effect 2, 20-40 Watt FORCED APC, 30-60 Watt
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Chronic bleeding

GAVE/radioproctitis APC probes with all beam forms	PULSED APC, Effect 2, 10-30 Watt
Angiodysplasia APC probes with all beam forms	PULSED APC, Effect 2, 10-30 Watt

Tumor reduction

APC probes with all beam forms	Tumors >15 mm: FORCED APC, >60 Watt Tumors < 15 mm: FORCED APC, 20-50 Watt
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Application

CUT

COAG

JET

Stent ingrowth/overgrowth

APC probes with all beam forms

PULSED APC, Effect 2, 40–60 Watt
FORCED APC, 20–40 Watt

Stent trimming

APC probes with all beam forms

FORCED APC, 30–60 Watt

ESD

HybridKnife, I, T, O types

Incision/Dissection:
ENDO CUT Q, Effect 2, cutting duration 3, cutting interval 3
DRY CUT, Effect 2, 80 Watt (improved hemostasis)

Coagulation:
FORCED COAG, Effect 2, 60 Watt

Mucosa elevation:
Esophagus: Effect 30–50
Stomach: Effect 30–50
Right colon: Effect 10–15
Left colon/Rectum: Effect 20–30

STER

HybridKnife, I, T, O types

Incision/Exposure:
ENDO CUT Q, Effect 2, cutting duration 3, cutting interval 3

Exposure:
SWIFT COAG, Effect 3–4, 70 Watt

Mucosa elevation:
Effect 30–50

Peroral Endoscopic Myotomy (POEM)

HybridKnife, I, T types

Incision/Exposure/Myotomy:
ENDO CUT Q, Effect 2, cutting duration 3, cutting interval 3

Exposure/Myotomy:
SWIFT COAG, Effect 3–4, 70 Watt
Coagulation:
FORCED COAG, Effect 2, 50 Watt

Mucosa elevation:
Effect 30–60

Barrett's esophagus

APC probes

PULSED APC, Effect 2, 50 Watt

HybridAPC

PULSED APC, Effect 2, 60 Watt (first ablation)
PULSED APC, Effect 2, 40 Watt (follow-up ablation)

Mucosa elevation:
Effect 40–50

Information

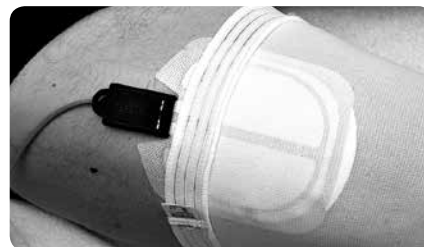
on safe use of electrosurgery and APC



Select a suitable patient plate



Attach the patient plate free of creases



The patient plate can be placed under the antithrombosis stocking

1. PLACE THE PATIENT IN AN ELECTRICALLY INSULATED POSITION

- Place the patient on an electrically insulated OR table pad in a dry condition
- Remove body jewelry (piercings, rings, chains, watches, bracelets, removable dental prostheses); taping over jewelry is not sufficient
- Position arms and legs so that they are insulated from the body by positioning them at an angle or by applying layers of gauze; avoid skin-to-skin contact if there are skin folds or breast folds (by interposition of dry gauze)
- The patient must not come into contact with any electrically conducting objects (e.g. drip stands, tubes)

2. SELECTING A SUITABLE PATIENT PLATE (PP)

- Self-adhesive divided PPs are preferable to undivided PPs and silicone electrodes
- For infants, use an appropriate PP
- As far as possible, always use divided PPs, as only these can be monitored by the safety system

3. SELECTING THE POSITION FOR THE PATIENT PLATE (PP)

- The PP can be positioned on the thigh, the upper arm or the side of the abdomen
- Affix the PP as close as possible to the operating field, but with a minimum distance of 15 cm
- The monopolar current should not be conducted via the body's electrical "bottlenecks" (e.g. elbow, knee)
- If possible, position the PP over electrically well-conducting tissue (muscle tissue)
- Do not affix the PP on fatty tissue, on bones/joints, on skin folds or on the head
- If possible, affix the PP on healthy tissue. Avoid scars, hemorrhages and tattoos
- The patient should not lie on the PP, on cables or on the cable connection
- When repositioning the patient, take care to ensure that the PP and the cable do not become detached or lie underneath the patient

Patients with active or passive implants

- For patients with a cardiac pacemaker or other conductive implants, use bipolar instruments wherever possible
- For monopolar instruments, apply the PP away from the implant and in such a way that the current is not conducted via the implant. Minimize the effect number (voltage) and power limitation (max. watts)

4. PREPARE THE SURFACE FOR ADHESION

- Do not attach the PP to hair. Shave the PP application site
- The PP application site must be dry and free of grease

5. ATTACHING THE PATIENT PLATE CORRECTLY

- Do not trim the PP
- Always attach oblong PPs with the long side facing the operating field
- Apply the PP over its entire surface without forming any creases; avoid air bubbles
- In the case of patients with antithrombosis stocking the PP can be affixed under the stocking with the connector and cable exposed
- Do not re-use self-adhesive PPs

6. AVOIDING IGNITION OF COMBUSTIBLE SUBSTANCES

- Avoid inflammable and combustion-supporting gases in the surgical field (e.g. anesthetic or endogenous gases)

Important rules

for the application of APC

1. HIGHER EFFICIENCY OF THE VIO GENERATION

When using VIO/APC-2 technology, it is important to consider that it offers a 50% increase in efficiency over that of the ICC/APC-300 technology.

2. APC PROBE ALWAYS IN THE FIELD OF VISION

In order to prevent damage to the tip of the endoscope and the instrument channel, the APC probe should protrude at least 10-15 mm from the endoscope, i.e. the first distal black ring of the APC probe must be visible. During dynamic application, the endoscope must always be moved back and forth together with the APC probe, never on its own.

3. ONLY WORK WHERE THERE IS ADEQUATE VISIBILITY

Good visibility must be ensured for all APC applications. Even though application of APC "around the corner", e.g. behind a fold, is permitted, such application should only be undertaken with sufficient practice and experience.

4. OBSERVE THE PENETRATION DEPTH AND DOSAGE

The penetration depth of the APC thermal effects depends on various factors (see above). When performing APC, energy should be applied with special care when working on thin-walled structures, especially the ascending colon; here a low power setting and short activation time should be used (also see recommended settings).

5. AVOID TISSUE CONTACT

The special tip of the APC probe should not be pressed into the mucous membranes during application to prevent the argon gas which is emitted from causing an emphysema. When in direct contact with the tissue the probe can cause contact coagulation or perforation on activation as well. During dynamic application, it is recommended that APC is only activated while the endoscope together with the probe are withdrawn. Especially in the case of very thin-walled structures, such as the right colon and the duodenum, the probe should be kept at a sufficient distance from the tissue (>1 mm) and it should not be pointed perpendicular to the wall. High current concentrations and localized thermal effects can arise that may lead to perforation.

6. AVOID PROXIMITY TO METAL OBJECTS

Do not bring the distal end of the activated APC probe into the proximity of metal clips, as a spark could jump across and cause inadvertent coagulation.

For this reason, where metal stents with exposed wires are involved it is important to keep the probe at a sufficient distance from them. Spark contact can cause accidental charring of the wire. In other cases this effect is desirable, for instance for shortening of metal stents ("stent trimming").

Caution: when using the PRECISE APC mode, contact with metal is not permitted due to the special plasma regulation.

7. DEFLAGRATION / GAS EXPLOSION

Given inadequate intestinal cleansing, any combustible, endogenous gases in the intestine can deflagrate and in the worst case explode. To avoid this, the following preventive measures should be considered:

- Avoid laxatives containing sugar
- Carry out orthograde colonic irrigation just before the planned intervention
- Remove residual feces close to the APC application site
- Remove gases by drainage or suction (using intestinal tube or insufflation of air, if necessary suctioning several times)
- Insufflation of inert gases such as CO₂ or argon
- Do not open up filiform stenoses or filiform closures primarily with APC

Glossary

Active electrode

The part of the electrosurgical instrument that delivers the electrosurgical current to the area of patient tissue where the tissue effect is required

Argon plasma coagulation

Monopolar non-contact coagulation. Electrically conductive argon plasma delivers the current to the tissue. Acronym: APC (Argon Plasma Coagulation)

Bipolar electrosurgery

Electrosurgical procedure in which both electrodes are integrated into a single instrument

Dessication

Drying out of biological tissue

Devitalization

Destruction of biological tissue

Diathermy

Synonym for electrosurgery or HF surgery

Electrosurgery

A synonym for HF surgery

Electrode

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

Frequency

Number of periods per second during which the current direction changes twice. Unit: Hertz (Hz). 1 kHz = 1000 Hz

Hemostasis

Staunching of bleeding

HF surgery

Use of high-frequency electric current on biological tissue with the goal of using heat to generate a surgical effect. Synonyms: HF surgery, diathermy, radio frequency (RF) surgery

High frequency

In terms of HF 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 electrosurgical current

Carbonization

Carbonization of biological tissue

Coagulation

1. Protein denaturation. 2. Electrosurgical effect in which proteins coagulate and tissue shrinks, promoting blood clotting significantly in this way

Lesion

Damage, injury or disruption to an anatomical structure

Power

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

Monopolar electrosurgery

Electrosurgical procedure during which the active electrode is used at the operative site and the electrical circuit is closed by a patient plate

Necrosis

Pathological cell death

Patient plate

Conductive surface, which is attached to the patient during a monopolar application in order to reabsorb the HF current. It feeds the current back to the electrosurgical unit in order to close the electrical circuit. Acronym: PP (patient plate). Synonyms: dispersive electrode, neutral electrode, return electrode

Cutting

Electrosurgical effect in which the intracellular fluid is explosively vaporized and the cell walls burst

Incision quality

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

Current density

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

Thermofusion

Sealing of tissue or vessels through coagulation

Vaporization

Vaporization of tissue

Burning under patient plate

Burning of the skin due to extreme generation of heat as a result of excessive current density under or at the patient plate

Additional references

PUBLICATIONS ON THE NEW APPLICATIONS – EXCERPT

BASIC PRINCIPLES

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LEAFLETS AND BROCHURES

- 85800-103 Fundamentals of Electrosurgery
- 85800-127 Application of Electrosurgery with Practical Recommendations
- 85800-117 User brochure: Polypectomy
- 85800-119 User brochure: Papillotomy
- 85100-158 Leaflet: HybridKnife product
- 85100-140 Leaflet: FiAPC probes
- 85140-190 Leaflet: VIO product range
- 85110-107 Flyer: POEM – Peroral endoscopic myotomy using Hybrid-Knife
- 85110-108 Flyer: Ablation of Barrett's esophagus with HybridAPC
- 85110-118 Flyer: Waterjet elevation prior to EMR or ESD
- 85810-126 Info folder for gastroenterology

Additional information:

Up-to-date product and application information, such as our accessories catalog, is available at www.erbe-med.com.

Up-to-date user videos are available at www.medical-video.com



Erbe Elektromedizin GmbH
Waldhoernlestrasse 17
72072 Tuebingen
Germany

Phone +49 7071 755-0
Fax +49 7071 755-179
info@erbe-med.com
erbe-med.com