What can therapeutic endoscopists learn from the use of electrosurgery in papillectomy?

Endoscopic papillectomy (EP) is recommended in patients with ampullary adenoma without extensive intraductal involvement, according to recent guidelines.¹,² The results are good regarding outcomes, but the quality of the evidence is only moderate, especially owing to the lack of a prospective comparison with surgical ampullectomy. EP is technically challenging, and it was graded as a level 4 ERCP procedure.³ A recent systematic review of 29 studies showed an overall adverse event rate of 25%, which was mainly related to postprocedural pancreatitis (PPP, 12%) and bleeding (11%).⁴ The high procedure-related morbidity of EP could be related to a variety of resection techniques as well as to pre- and postprocedural measures. Unfortunately, their independent impact on the efficacy and safety of EP is not well known. Most of the recommendations are weak and have a low quality of evidence.¹,² A recent Delphi process achieved consensus of experts on only 59% of 79 statements, mainly related to the technical aspects of EP.⁵ It is recommended to perform EP with a snare, preferably in an en-bloc fashion without submucosal injection.¹,² There is no evidence of superiority of one type of snare over another.¹ Pure cutting and blended current have been used with high adverse event rates for both methods, according to a systematic review of uncontrolled series on EP.⁶ A small randomized controlled clinical trial showed similar efficacy and safety for a fractionated cutting (endocut) mode and pure current, respectively.⁷ Power settings have not yet been standardized.

What we know so far suggests that the mode and settings of electrocautery have no significant effect on EP results. However, the level of evidence is low, and further research seems necessary with the aim of minimizing EP-related morbidity.⁸ In theory, the risk of PPP could be reduced by the use of a thin snare wire. It maximizes current density for swift transection and avoidance of thermal injury to the pancreatic orifice and the resection surface that may cause delayed bleeding.⁹ The same goal should be achieved by the use of a purecut mode. By contrast, techniques that minimize coagulation may increase the risk of periprocedural bleeding. This can usually be managed with endoscopic techniques, but it impairs the identification of the pancreatic orifice for the placement of a stent, which is recommended to reduce the risk of PPP.¹,² The endocut mode promises a compromise between cutting too fast and coagulating too much. It automatically controls the cutting mode, with the cut and coagulation current cycled at repeated intervals. Its use for EP is suggested by the European Society of Gastrointestinal Endoscopy and a consensus of experts with a 94% agreement.²,⁵ By contrast, the American Society for Gastrointestinal Endoscopy does not refer to pulsed modes and does not prioritize between pure cutting current and blended current.¹ A recent review reported on EP with the endocut mode in 12 uncontrolled studies. The rates of bleeding and postendocut pancreatitis varied considerably between 0% to 42% and 0% to 18%, respectively. These discrepancies are not well understood. They may be related to an indeterminate definition of bleeding, use of different types of snares and electrosurgical generators, or deviations in power settings among studies.⁶ Therefore, it was with great interest that we read the report of Yamamoto et al¹⁰ in this issue of Gastrointestinal Endoscopy. The authors performed for the first time animal experiments and a small clinical study to determine the optimal endocut settings for EP. They used the latest model and previous generations of electrosurgical units (ESUs) of a specific company. The newest technology allows the practitioner to choose between 2 cutting modes and to modify the level of coagulation (effect), the incision time (cutting duration), and the cycle for incision time.
and incision pause time during which coagulation is applied (interval). An automatic electric arc (spark) detection ensures a reproducible and controlled cutting result.

Three animal experiments were performed, 2 in models and 1 in a living pig, to determine the incision force and the coagulation effect related to a variety of different settings that can be chosen depending on the generation of ESUs. The authors also studied the impact of the size of targeted lesion and the weight that was suspended from the snare handle. The incision force was determined by the incision count and the incision time as measured according to the spark indication sound generated by the ESU. The coagulation effect was quantified by measuring the diameter of resulting white tissue around a needle electrode inserted into a pig liver. The experiment in a living pig included endoscopic evaluation of the resection surface immediately after EP, the next day, and 1 week afterward. These studies produced many results, which were subjected to univariate and multiple regression analysis. Some findings were unexpected and are not easy to interpret. In this context, cutting duration was determined as the main factor of the incision force, and higher settings caused more denaturation of the tissue. Increasing the interval setting reduced the cutting duration and consequently decreased the coagulation effect.

The experiments also enable the comparison of effects among the different ESU generations. The latest model was used for EP in a clinical study on 10 consecutive patients. According to the experimental results, the ESU was set to the mode endocut I and to levels 1 for effect, 3 or 4 for duration, and 1 or 2 for interval. A biliary and a pancreatic stent were prophylactically inserted, and the distal side of the resection wound was closed with clips after EP. No adverse events were registered within 3 months. Endoscopy was routinely performed 1 week after EP for stent removal. It revealed clinically inapparent ampullary strictures and deep ulceration in 2 cases. The authors discuss potential reasons for these findings in detail. They may be related to a long coagulation time before the first incision that was not observed in the experiments.

An additional animal experiment revealed that the use of a thinner snare wire reduced the coagulation effect, especially in the case of EP of large and firm lesions. In conclusion, they recommend a thin snare wire, endocut I mode, and settings of 1–4–1 for effect, duration, and interval, respectively. This EP mode was considered to be ideal for papillectomy and should minimize the risk of adverse events.

The authors of this study should be commended for the well-designed trial, which provides previously unknown insights into effects of electrosurgery on EP. However, some limitations of the trial should be considered before the routine use of the suggested EP mode in clinical praxis. All investigations were performed with different ESU models of a specific company. The newest generation allows 320 different settings for applying endocut. Only a part could be investigated despite many experiments. Measurements were related to the spark indication sound. However, this does not allow measurement of the dynamic initial cutting phase and differentiation of it from the coagulation cycle. In contrast to the findings of the experiments, the setting of the cutting interval has no impact on the cutting duration, according to the technology of the ESU used. Extending the cutting interval causes longer incision pauses and therefore more coagulation, at least in settings with coagulation (effect levels 2–4).

The results cannot be transferred to ESUs of other companies because of different technologies. It is not known to what extent the findings of the animal experiments can be extrapolated in humans, eg, owing to differences in tissue density and vascularization. On the other hand, the human study is too small to evaluate the incidence of PEP and delayed bleeding. The risk is probably small regardless of settings under consideration of prophylactic stenting and clip closure of the resection surface. There is no agreement among experts on the necessity of the latter. The EP mode proposed by Yamamoto et al induces fast cutting with very little coagulation effect. The difference to pure cutting is small in clinical practice, especially for EP of small lesions and especially if a thin wire is used.

What lessons can endoscopists learn from the study? The most important message is that they should be familiar with the technology of ESUs. Various modes and settings can differ considerably in their effect on tissue, and that may have an impact on clinical outcomes. It is convenient to prefer simply constructed ESU models that provide only a few fixed modes and power settings. These may be appropriate for less complex procedures, eg, polypectomy or colorectal EMR. However, the latest ESU technologies allow to choose between established preselected modes or different variations of fractionated current. It seems to be impossible to demonstrate their advantage and to identify the optimal settings at a high level of evidence in clinical practice. This is a consequence of the large variation of different settings and other factors that influence tissue resection, such as accessories and their handling. However, modern ESUs enable a personalized application of current, considering procedural and tissue characteristics, type of instruments, or patient risk factors. An example of such an option for EP is a gradually controlled increase of coagulation effects by choosing a higher effect and a longer cutting interval during the procedure when cutting is going too fast and induces bleeding under the EP mode.

When therapeutic endoscopy is compared with flying an airplane, it is usually comfortable for both to operate automatically. However, endoscopists and pilots should both know the background of modern preselected modes and algorithms. They must be able to make individual adjustments for every challenge at all times.
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Abbreviations: EP, endoscopic papillectomy; ESU, electrosurgical unit; PPP, postprocedural pancreatitis.

REFERENCES