New Kid on the Block: "Speedboat"

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Abstract

Innovations in devices and techniques have parallelly propelled the field of therapeutic endoscopy in gastrointestinal tract. With the development of endoscopic resection techniques and the availability of newly designed electrosurgical knives, the minimally invasive management of early gastrointestinal neoplasms has revolutionized. The currently available electrosurgical knives are monopolar devices, not equipped with injection needle and required to be exchanged with coagulation forceps for hemostasis. Monopolar electrosurgical devices require higher voltages with associated risks. A recent innovation in the field of endoscopic knives is a new device called "Speedboat" device, specially designed for use in endoscopic dissection procedures. This is a bipolar device that utilizes radio frequency energy for cutting and microwave energy for achieving hemostasis. Speedboat device possesses hemostasis capability and has an integrated injection needle that imparts an "all-in-one" quality to this device. Preliminary data suggest the safety and utility of this device in performing a variety of endoscopic dissection and resection procedures including endoscopic submucosal dissection, per-oral endoscopic myotomy, and resection of subepithelial tumors.

Keywords

- electrosurgical knives
- bipolar
- radio frequency
- microwave
- endoscopic submucosal dissection

Introduction

The field of therapeutic endoscopy has witnessed revolutionary advances over the last several decades. Endoscopic resection techniques have been developed for safe and effective removal of early gastrointestinal neoplasms. Similarly, the development of third space endoscopy has revolutionized the management of achalasia and subepithelial tumors.[1] Recent innovations in the endoscopic devices and accessories have propelled the field of therapeutic endoscopy. The development of new knives with integration of water jet has simplified the job of endoscopists.[2,3] Although integration of water jet into electrosurgical knives has reduced the need for exchange of accessories, separate accessories are still required for initial submucosal lifting injection as well as achieving hemostasis. A new bipolar device, Speedboat-RS2, has been recently made available for commercial use, which potentially overcomes this issue by integrating injection needle and hemostasis capability within a single device.

This review focuses on this novel, all-in-one bipolar device designed for use in endoscopic submucosal dissection (ESD) and submucosal tunneling procedures including per-oral endoscopic myotomy (POEM) and submucosal tunneling endoscopic resection (STER).

Speedboat Device: Specifications

Speedboat (Speedboat-RS2; Creo Medical Ltd, Chepstow, Wales, United Kingdom) is a novel bipolar device designed for ESD and tunneling procedures (►**Fig. 1**). As the name suggests, the device appears like a "speedboat" with slimmer distal end and broader proximal part (►**Fig. 1A**). The device is

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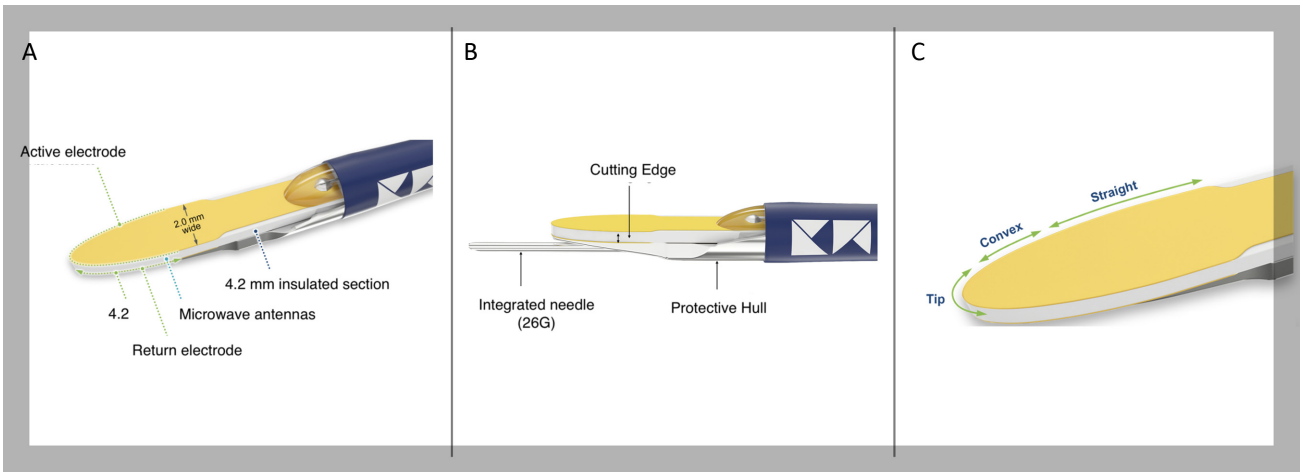

Fig. 1 Specifications of the Speedboat device (with permission from Creo Medical Ltd, Chepstow, Wales, United Kingdom). (**A**) Top surface of the device demonstrating the distal cutting (4.2 mm) and proximal (4.2 mm) insulated sections of the device. (**B**) Side view of the device depicting the integrated needle (26 G) and protective hull at the bottom. (**C**) Close view of the device demonstrating the three parts of the cutting edge, that is, tip, convex edge, and straight edge.

fully rotatable with working length of 2,300 mm and width of 2 mm. The device has two cutting blades along lateral sides. The bipolar energy is released from the top blade and travels to the bottom blade that acts as a return electrode or return pad. The distal 4.2 mm of the blade is the cutting edge and the proximal 4.2 mm part is insulated (►**Fig. 1A**). This feature allows the device to be extended and retracted as per the convenience of the operator. The device has a protective hull at the bottom that has been designed to protect the muscle bed from thermal damage by maintaining distance of energy sources from muscle bed and offer stability to the device during dissection (►**Fig. 1B**). It is equipped with a 26 G needle that emerges from the bottom and allows submucosal injection during the endoscopic dissection and tunneling procedures.

Speedboat has three edges for specific steps during endoscopic dissection procedures, that is, tip, convex, and straight (►**Fig. 1C**). The tip and convex edges are used for mucosal incision, initial part of submucosal dissection, and dissection of fibrotic tissue. The convex and the straight edges are used for majority of the submucosal dissection procedure.

The device functions by delivering radio frequency (RF) energy for mucosal incision/dissection and microwave energy for coagulation. A separate electrosurgical generator is required for functionality of this device (Creo Medical electrosurgery generator 7-EMR-050). The standard settings for RF and microwave energy are 400 kHz, 35 W; and 5.8 GHz, 10 W, respectively (►**Fig. 2**; ►**Table 1**).

Tips and Tricks for Using Speedboat Device

We have described the use of this device in our previous study and several video case reports.[4–7] In brief, the standard steps of ESD and tunneling endoscopic procedures remain the same (►**Figs. 3**– **6**). The device is compatible with endoscopes with a working channel diameter of at least 3.7 mm. While using

Fig. 2 Electrosurgical generator for delivering radio frequency and microwave energy (with permission from Creo Medical Ltd, Chepstow, Wales, United Kingdom).

Table 1 Specifications of the novel Speedboat device

	Device specifications	Dimensions
1.	Working length	2,300 mm
2.	Width of device	2 mm
3.	Length of cutting portion	4.2 mm
4.	Length of insulated portion	4.2 mm
5.	Compatible working channel	3.7 mm
6.	Settings on generator: • Radio frequency energy (dissection) • Microwave energy (coagulation)	 400 kHz, 35 W 5.8 GHz, 10 W

Speedboat device, it is important to keep the top bipolar plate in contact with the tissue for transmission of RF energy and effective dissection. Therefore, the orientation of the device and coordination with the assistant maneuvering the device is crucial to guarantee efficient dissection. As mentioned before, the tip and convex edges of the device are used for mucosal incision and initial submucosal dissection. The bulk of the dissection is performed using the convex and the straight edges of the device by sweeping inside-out movements, that is, from center to left and right. The protective hull should always lie flat on the muscle bed for maintaining a safe distance from the muscle fibers and preventing any inadvertent injury during ESD (►**Fig. 3**).

Precoagulation of small vessels is achieved by applying gentle pressure to the vessel and activating the microwave for ≤10 seconds. In case of larger vessels, similar approach is applied along both sides of the vessels until the vessel has been effectively coagulated. Since microwaves provide with more controlled tissue heating, it is applied for up to 10 seconds each time. In instances of active bleeding, the tip of Speedboat is used to tamponade bleeding before activating microwave to achieve hemostasis (►**Fig. 4**). The following are links for videos demonstrating the technique of endoscopic dissection using Speedboat device:

- STER: https://s20.video-stream-hosting.de/tvg/ejournal/10.1055-s-00000012/10-1055-a-1089-7680-1446evv01_360p.mp4
- ESD: https://s20.video-stream-hosting.de/tvg/ejournal/10.1055-s-00025476/10-1055-a-1220-6562-1896eiv01_360p.mp4
- POEM: https://www.videogie.org/cms/10.1016/j.vgie.2019.12.009/attachment/f0f318c8-23ef-48af-94e5-21e358a9fc29/mmc1.mp4

Literature Review

Safety and Efficacy in Animal Studies

Saunders et al initially reported the use of Speedboat device in porcine models.[8] The authors performed eight consecutive resections (seven in colorectum and one in antrum) and analyzed the resection defects histologically. The median time to complete a resection was 37 minutes (range: 30–60 minutes). Median defect size (longest diameter) was 53.5 mm (range: 40–80 mm). There were no perforations and histology showed an intact and viable muscle layer in all cases.[8] In subsequent studies, the authors compared the safety and efficacy of ESD using Speedboat device to the

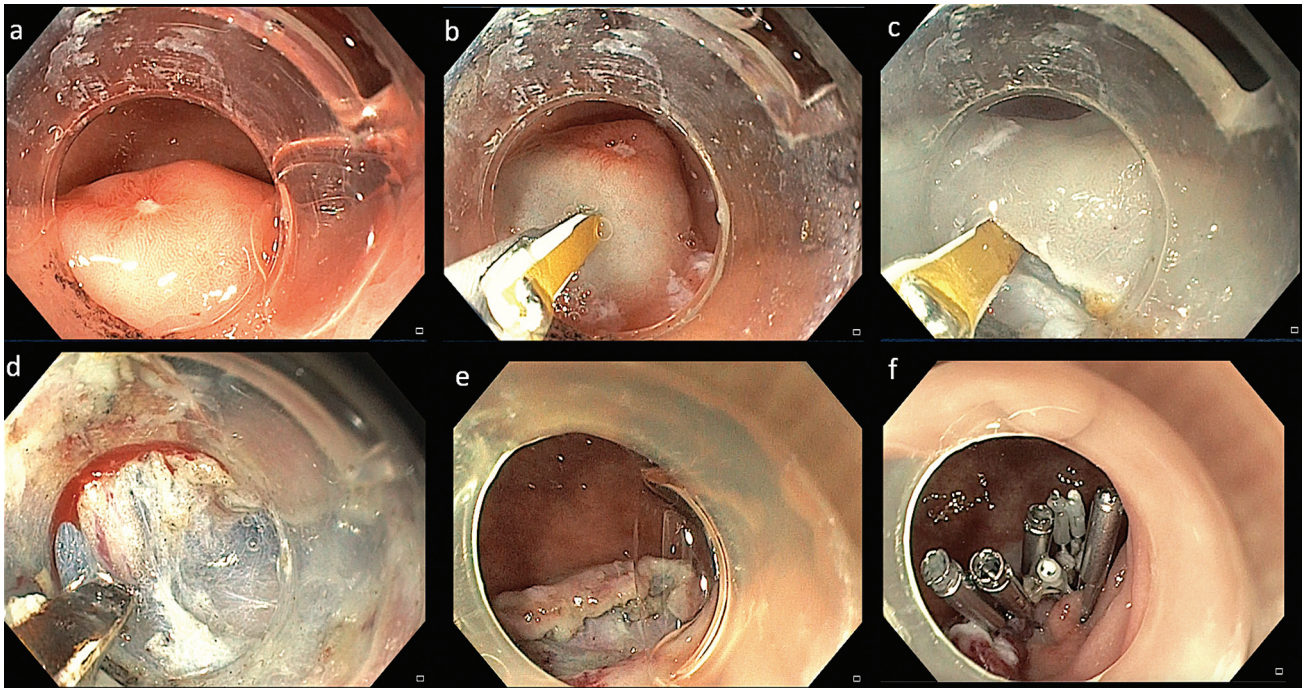

Fig. 3 Endoscopic submucosal dissection of a gastric neuroendocrine tumor (NET; reproduced with permission from Nabi et al, 2020[5]). (**a**) Endoscopic view of gastric NET along greater curvature of stomach. (**b**) Submucosal lifting injection with the integrated needle system. (**c**) Mucosal incision using the tip of device. (**d**) Submucosal dissection using the convex and straight cutting edges of the device. (**e**) Submucosal defect after complete resection. (**f**) Closure of the defect using loop-ring technique.

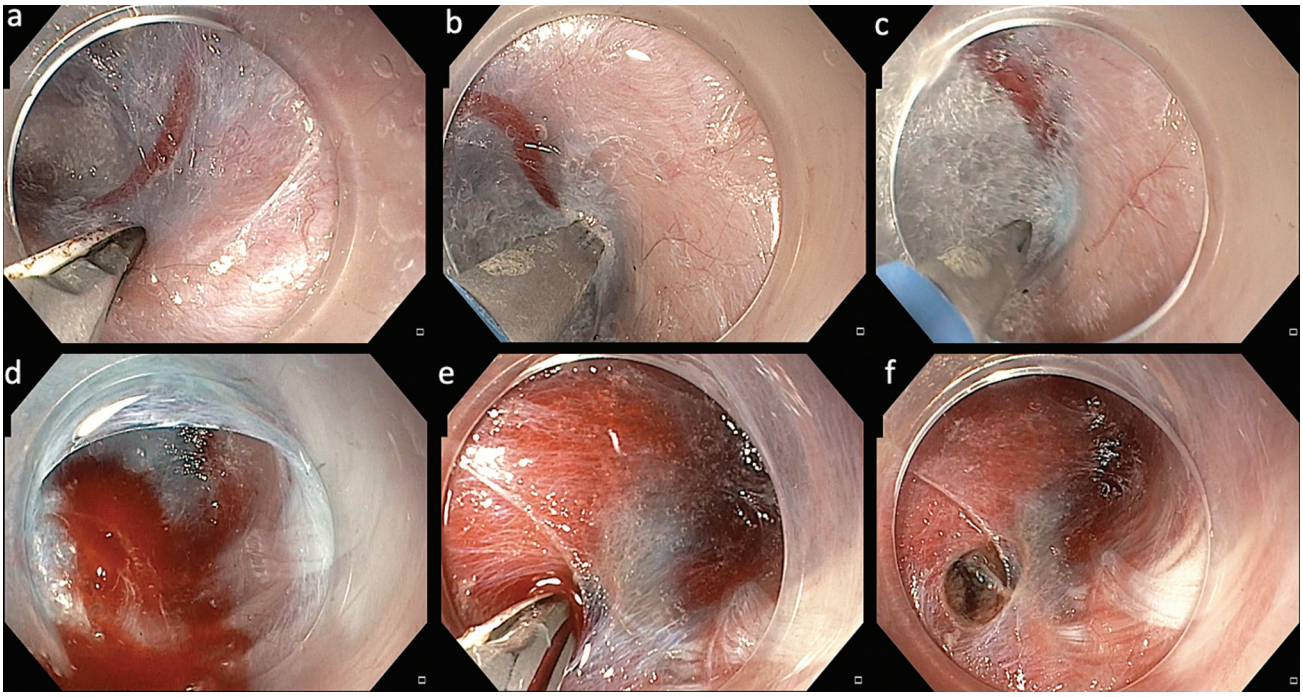

Fig. 4 Technique of precoagulation and control of active bleeding with Speedboat device. (**a**) Large vessel encountered during submucosal tunneling. (**b**) Gentle pressure on the vessel with the device and activation of microwave energy. (**c**) Confirmation of coagulation at the origin of vessel from the muscle bed. (**d**) Active bleeding during submucosal tunneling. (**e**) Tamponade of the bleeding point with the tip of the device followed by activation of microwave energy. (**f**) Successful hemostasis after microwave coagulation.

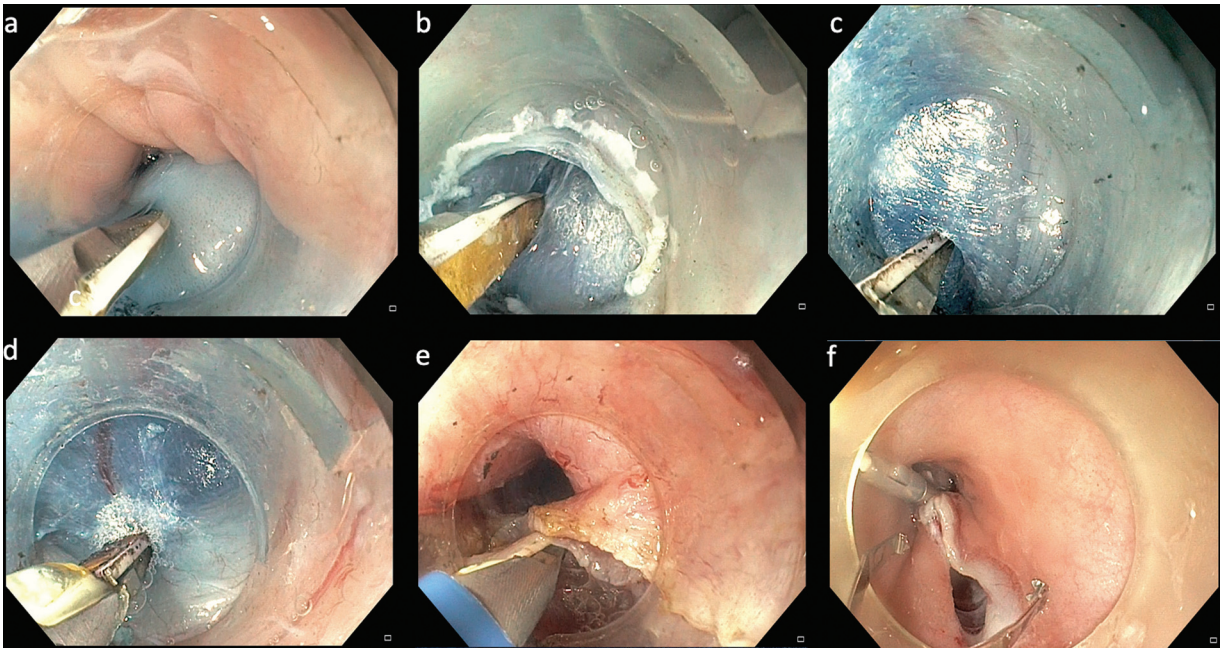

Fig. 5 Per-oral endoscopic myotomy using the new bipolar device (reproduced with permission from Nabi et al, 2020[5]). (**a**) Submucosal injection using saline mixed with indigo carmine. (**b**) Mucosal incision after rotating the device so that the lateral cutting edge comes in contact with the mucosa. (**c**) Submucosal tunneling with the same device (note orientation of device). (**d**) Coagulation of vessels using microwave energy. (**e**) Myotomy (circular only in the upper part and full thickness in the lower part). (**f**) Closure of mucosal incision with multiple endoclips.

conventional monopolar knives. In one study, microwave coagulation was found to be equivalent to Coagrasper (monopolar) and Gold Probe (bipolar) but with less muscle alterations in the histological specimens.[9] In another study, the authors compared bipolar RF cutting and monopolar cutting (Flush-knife-BT/F-BT/Fujifilm, Japan) for ESD.[10] Ten consecutive resections were performed in the colorectum (two per animal), five each with Speedboat and Flush-knife-BT. Compared with Flush knife-BT ESD, the use of Speedboat device was associated with less muscle injury and need for

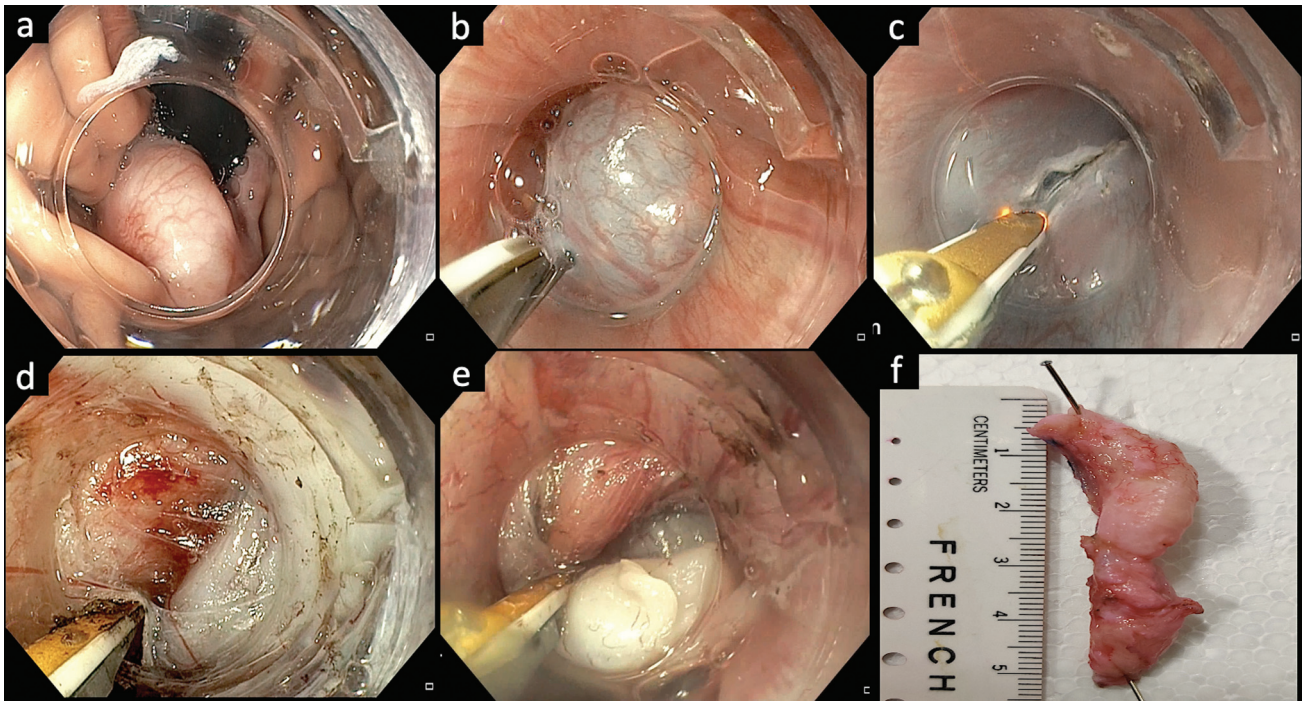

Fig. 6 Submucosal tunneling endoscopic resection in a case with esophageal submucosal tumor (reproduced with permission from Nabi etal. 2020, ref 6). (**a**) Esophageal submucosal tumor extending into cardia. (**b**) Submucosal lifting injection. (**c**) Mucosal incision few centimeters above the tumor. (**d**) Submucosal dissection to expose the tumor. (**e**) Dissection of the attachments of the tumor. (**f**) En-bloc removal of the tumor.

endoscopic clipping. However, intraprocedural bleeding requiring the use of coagulation forceps was more frequent in the Speedboat group.[10]

Data from Human Studies

The safety and efficacy of Speedboat device in animal models propelled its use in human cases. The use of Speedboat device was initially described for ESD in colorectal lesions.[8,11,12] More recently, submucosal tunneling procedures including POEM and STER have been successfully performed using Speedboat device.[4–7,13]

The group from St Mark's Hospital initially reported the outcomes of ESD in 64 cases with colorectal polyps.[14] The median size of the polyps was 4 cm and about half of the polyps were located proximal to rectum. Complete en-bloc resection was achieved in 83% and no recurrence was observed in the patients eligible for first surveillance visit. The median procedure time was 90 minutes (range: 15–270 minutes). Importantly, monopolar coagulation forceps for hemostasis was required in only 12.5% cases. There were no full thickness perforations and minor muscle injuries not requiring endoclips were observed in 5.6% cases. The size of polyp, granular nature, and location proximal to rectum were predictors of increased procedure duration.[14] Subsequent to this study, several case reports have been published demonstrating the feasibility and safety of performing ESD in colorectum and stomach using Speedboat device.[7,11,12] More recently, Speedboat device has been utilized for performing third space endoscopy procedures. Nabi et al reported the utility of this device for performing submucosal tunneling procedures including POEM and STER (►**Figs. 5** and **6**).[4,6] The same authors evaluated the performance of Speedboat device in 10 patients who underwent ESD and submucosal tunneling procedures.[5] The procedures included POEM ($n = 7$), STER for esophageal subepithelial tumor ($n = 1$), ESD for rectal polyp ($n = 1$), and gastric neuroendocrine tumor ($n = 1$). All the procedures were successfully completed. Importantly, exchange of accessories was not required in eight cases (80%). Subsequently, other authors have also reported feasibility of POEM procedures with Speedboat device.[13]

Speedboat: Potential Advantages and Limitations

The potential advantages of Speedboat device over the conventional monopolar knives are manifold (►**Table 2**). The device is *all in one* and capable of executing submucosal injection, dissection, and coagulation. Therefore, the requirement of multiple accessories for different steps during ESD or POEM is reduced, which may potentially reduce the duration as well as the cost of the procedure. RF energy allows precise dissection without much charring as may be the case with conventional coagulation modes applied using monopolar knives. The bipolar nature of Speedboat device improves the safety of the procedure due to predictive path of energy, which in turn minimizes the collateral transmission of energy during dissection as well as coagulation. This reduces inadvertent injury to the muscle bed during ESD or mucosa during POEM. While using monopolar devices, the electricity travels a longer distance, that is, from device to returning pad on patient. Therefore, higher voltages are required and the path of electricity is relatively unpredictable with monopolar devices potentially increasing the chances of remote burns. The presence of protective hull at the bottom of the Speedboat device allows the endoscopist to rest the device on the muscle bed while performing lateral dissection without risk of injury to the muscle fibers during ESD.

Table 2 Comparison of Speedboat device with the conventional knives used for endoscopic submucosal dissection procedures

	Speedboat device	Conventional knives	Comments
Type of knife	Bipolar	Monopolar	Energy pathway is localized with bipolar devices
Integrated needle	Yes	No	26 G needle integrated with Speedboat
Hemostasis: large vessels	Yes	No	Exchange with coagulation forceps required while using monopolar knives
Exchange of accessories	Less	More	Coagulation forceps and injection needle required while using monopolar knives
Working channel requirement	3.7 mm	2.8 mm	Therapeutic channel scopes required while using Speedboat device
Typical energy for cutting	Radio frequency	Coagulation modes (Swift or Forced) and Cutting modes (EndoCut or Dry Cut)	Lower voltage required for similar effect; charring is less as compared with monopolar knives
Typical energy for coagulation	Microwave	Soft coagulation	Coagulation is slower with microwave (up to 10 seconds)

There are few noteworthy limitations of Speedboat device. First, the device is bulky and compatible with therapeutic channel endoscopes only. Some endoscopists may not prefer a therapeutic channel endoscope for performing ESD or POEM procedures due to larger size. In near future, the availability of a slimmer version of this device (Speedboat Slim) may allow the use of a wider range of endoscopes. Second, the requirement of a dedicated electrosurgical generator along with Speedboat device incurs additional costs. The additional cost of the generator is partially circumvented by reduced requirement of additional accessories during the endoscopic resection procedures. Third, a close coordination is required between the endoscopist and the assistant maneuvering the device for optimum orientation during dissection. Fourth, the Speedboat device has been designed to achieve hemostasis by contact method in contrast to grasping of the bleeding point while using conventional coagulation forceps. Hemostasis with microwave energy is slow and several applications (up to 10 seconds) may be required before hemostasis can be secured. Therefore, coagulation forceps may be required especially during early phases of using this device. Finally, it may take several cases to adapt to the proper use of this device and the "boat" may not gain "speed" till then.

Summary

Speedboat is a novel bipolar device that utilizes advanced energy (RF and microwave) for dissection and coagulation, respectively. Preliminary data suggest the feasibility and safety of endoscopic dissection and tunneling procedures while using this device. Although the device appears promising, larger studies are required to conclude its proposed advantages for tissue resections. In addition, comparative trials are required with the conventional monopolar knives. In this regard, an ongoing randomized trial (NCT04919824) is comparing the performance of Speedboat device with monopolar knives.

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Conflict of Interest
None declared.

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