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ORIGINAL ARTICLE

Ex vivo nonbiomaterial gel-based model for endoscopic training

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INTRODUCTION

EndoGel (Sunnarow Limited, Tokyo, Japan) is a novel ex vivo nonbiomaterial gel-based training model that realistically simulates intestinal mucosal and submucosal layers using polyvinyl alcohol hydrogel (PVA-H) materials. It is designed to behave similarly to en vivo environments and can be used as an alternative to ex vivo animal organs. Prior literature shows its use in advanced techniques such as endoscopic submucosal dissection (ESD) and peroral endoscopic myotomy (POEM).[1,2] However, data to suggest its use for basic endoscopic interventions are lacking. Here, we showcase the potential applications of this model for foundational endoscopic techniques (Video 1, available online at www.videogie.org).

EQUIPMENT AND SETUP

There are 5 core components:

1. Nonbiomaterial gel model
2. Return electrode
3. Hose (dummy overtube)
4. Box used for securing the nonbiomaterial gel
5. Platform used to fix hose and allow scope advancement

First, fold the main box posteriorly to create a stable base. Then, affix the return electrode to the main box through alignment with the preplaced adhesive markings. Place the nonbiomaterial gel upon the return electrode. Next, position the platform used to fix the hose within the main box. Use of the hose to secure the endoscope is optional. Finally, secure the entire unit with medical or silk tape (Fig. 1).

Abbreviations: ESD, endoscopic submucosal dissection; POEM, peroral endoscopic myotomy; PVA-H, polyvinyl alcohol hydrogel.

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TECHNIQUES

A total of 5 endoscopic techniques were tested. The first endoscopic technique was a circumferential marking using T-shaped ESD knife and soft coagulation (Effect 2, Watt 25) (Fig. 2). This platform responded similarly to real mucosa; however, variation in coagulation settings should be considered to achieve optimal marking. The simulated mucosa also performed similarly well during submucosal lifting using a needle injector and saline mixed with blue dye revealing an adequate lift (Fig. 3). Mucosal incision performed on the PVA-H material responded akin to en vivo environments (Fig. 4). Next, a hot snare polypectomy of a 1-cm simulated polyp was successful using an oval-shaped 1.5-cm hot snare (Fig. 5). Finally, the polypectomy defect site was closed via three 17-mm hemostatic clips with adequate tissue approximation (Fig. 6). Overall, this artificial model accurately simulated ex vivo animal models and en vivo mucosal tissue for basic endoscopic techniques.

DISCUSSION

As endoscopic techniques continue to develop, there is an increasing demand to find suitable training platforms to appropriately train novice endoscopists. The use of porcine and bovine ex vivo models has been widely used for training; however, they may be associated with increased cost, cumbersome storage requirements, need for particular training endoscopes, ethical concerns, and decreased availability and reusability.[3-7] Additionally, the use of artificial training simulators is not a novel phenomenon and has been used since the 1990s in both physical and virtual settings. Some of these physical models were developed for a singular technique, limiting their use.[8] Virtual reality simulators are also restrictive because of their high cost and because they allow limited tactile feedback.[8] Recently, advances in new materials such as PVA-H have enabled artificial models to mimic en vivo environments through its conductivity as it consists mainly of water. Moreover, it is layered according to intestinal anatomy, and the submucosal layer is designed to retain liquid.[9] This nonbiomaterial gel has previously shown efficacy in practicing advanced techniques such as ESD and POEM.[1,2] However, many of the foundational techniques have not been tested successfully on this training model up until now. Some limitations do exist, however, such as performing snare polypectomy without mucosal

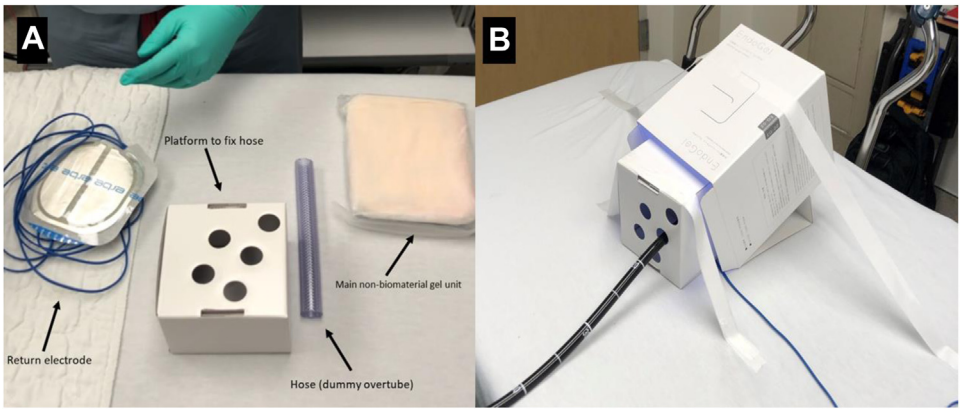

Figure 1. A, Artificial model components. **B,** Training platform setup.

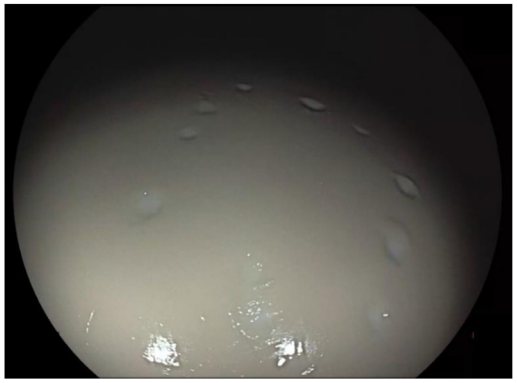

Figure 2. Thermal marking using T-type endoscopic submucosal dissection knife and soft coagulation (Effect 2, Watt 25).

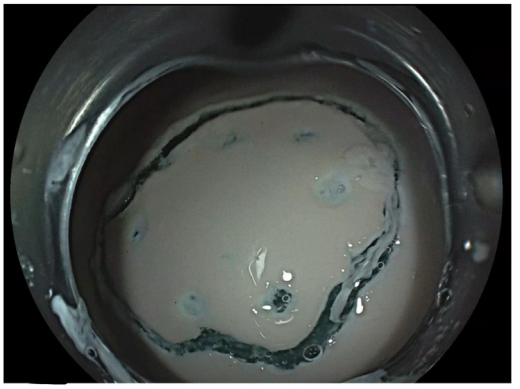

Figure 4. Mucosal incision performed with T-type endoscopic submucosal dissection knife and endocut settings.

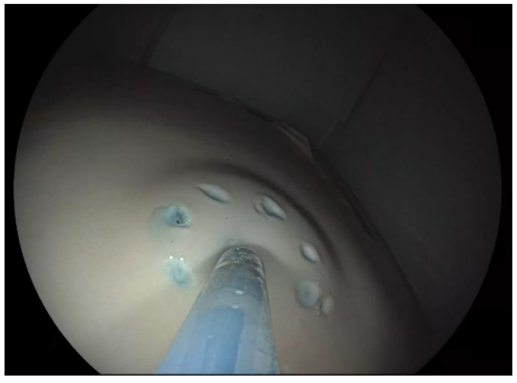

Figure 3. Submucosal lift using saline and blue dye with standard needle injector.

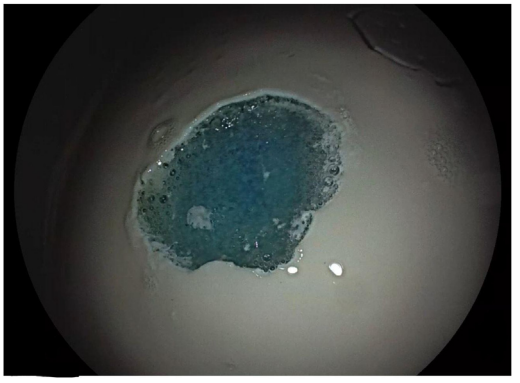

Figure 5. Postpolypectomy with removed specimen.

incision, because of the difficulty in grasping tissue. These may be overcome with improved lifting or different snares.

The ability to learn basic endoscopic skills on this new platform will have considerable implications on fellowship training. It has the capability to improve access, streamline workflow, and provide novice endoscopists further training to master the basics before moving on to more advanced interventional techniques.

DISCLOSURE

The authors disclosed no financial relationships.

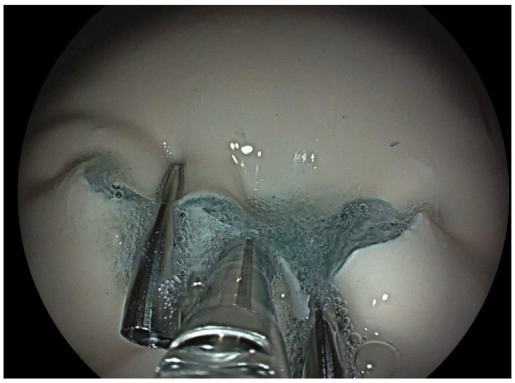

Figure 6. Closure of artificially made defect using clips.

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