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Device-assisted enteroscopy training. A rapid review

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ABSTRACT

Device-assisted enteroscopy is currently lacking a validated training model, in contrast to the other major technique used for the study of the small bowel, namely capsule endoscopy. Training should be based on defining and achieving competency for the acquisition of the knowledge and skills required to perform enteroscopy in a safe and effective manner. The need for training is clear, since the technique is considered an advanced endoscopy form that requires maneuvers that differ from the usual ones that must be learned, in addition to specific equipment. Therefore, the ideal candidates for this training include professionals with accredited experience in therapeutic digestive endoscopy. Amongst the recommendations issued regarding device-assisted enteroscopy training, the estimation of small-bowel insertion depth and the choice of the examination route, whether oral or anal, should be highlighted. Learning curve descriptions have the limitation of being explorer-dependent with no

consensus on the parameter that should be selected to establish a correct learning curve in enteroscopy. The most commonly used parameter is insertion depth. The few training models that have been proposed recommend using a highly useful tool, namely simulators and to start practicing under expert guidance. Based on the variability of published data, an experienced endoscopist may perform enteroscopy in a safe and effective manner after 5 to 35 training procedures. Although reaching the expert level requires prolonged clinical practice with exposure to the various disorders of the small bowel.

INTRODUCTION. STATE OF THE ART

Ever since the advent of capsule endoscopy (CE) and overtube-assisted enteroscopy (OAE) techniques, studies and therapeutic endoscopy of the small bowel (SB) have advanced dramatically. Training for OAE has not been standardized yet, despite the years that have elapsed and in contrast with training for CE (1,2). The barriers to OAE introduction in endoscopy units are well known, since each therapeutic technique has a specific learning curve (LC) (3). These include the costs associated with new equipment and consumables, increased procedure duration, insufficient number of potential patients with a benefit and high specialization requirements. Specifically, OAE devices currently established include primarily double-balloon enteroscopy (DBE), single-balloon enteroscopy (SBE) and spiral enteroscopy, including its recent motorized version.

Medical training has changed over the last decades due to resource optimization. Operating room time must be kept to a minimum, both because of legal aspects and the newer medical technologies that are increasingly complex and require more extensive training and specialist qualification. Classical learning in digestive endoscopy is based on supervised training, which starts with attending endoscopic procedures as an observer, then as an assistant, then gradually performing simple endoscopic techniques. This requires a safe LC and is highly dependent on supervision extent, which occasionally results in an excessive duration (4). However, endoscopic procedure training and development are presently orientated to acquiring competencies and defining indicators to ensure procedure quality, rather than to

develop a LC, which results in optimal clinical outcomes (4).

Importantly, the time and experience required to learn and safely and effectively perform endoscopic examinations are highly variable among endoscopists and also among procedure types, particularly for advanced techniques. Thus, developing a core curriculum to define which competencies are required for expertise in each technique is more important than establishing a single LC for all professionals.

An LC is a graphic representation that shows the success level acquired during learning over time. In OAE, the parameter established by different studies as a marker of success is insertion depth. However, training based on a general learning curve exclusively focused on a single aspect is not a robust approach. Therefore, it is necessary to define which competencies should be acquired that includes a number of recommendations, allowing an assessment of the knowledge gained, as well as trainee skills. There is an increasing awareness that competency must be based on capability rather than on the absolute number of procedures performed, which is reflected by interpersonal differences in learning curves (5). Unfortunately, minimal training requirements conducive to competency in OAE have not been validated. To date, they are exclusively based on expert opinions (4).

From all the above, the goal of this study was to provide a synthetic review and to assess the state-of-the-art training in OAE.

NEED FOR TRAINING IN DEVICE-ASSISTED ENTEROSCOPY. REQUIREMENTS

Highly experienced endoscopists consider OAE a technique that demands specific skills that require specific training. This is due to the fact that both equipment and required maneuvers are exclusive to these procedures (6,7) (Table 1). Both the ASGE and ESGE have published the learning guidelines for several endoscopic procedures, as well as the training models to be followed for skill acquisition and subsequent recognition. However, no definite rules exist with respect to OAE (2,4,8).

OAE is considered an advanced procedure that requires previous long-term training in general endoscopy to ensure a suitable ground on which to base the LC. Furthermore, the technique is restricted to a small group of endoscopists due to its limited number of procedures, as is also the case with other advanced endoscopic techniques (4,6,8).

Different papers have reported a number of OAE training requirements. These are primarily focused on trainee, mentor and facility aspects (5-6,9).

Regarding the trainee staff, there is a unanimous agreement that training may begin with any of the three known OAE modalities. Furthermore, accredited experience in digestive endoscopy is a requirement. In addition, unavoidable requirements include having completed the LC for techniques that are highly useful in OAE, including hemostasis, polypectomy and stricture dilation. ASGE also describes the need for accredited hands-on courses for a minimum of 8 hours (5,6). Joint training in CE and OAE is advisable as it enhances SB lesion recognition, which entails a higher diagnostic yield (7,10). Kim and Buscaglia also report on the usefulness of extensive experience in ERCP, since OAE is commonly used for patients with altered gastrointestinal anatomy (6,9).

Mentors should be OAE experts with highly developed teaching skills, preferably a minimum of two per training center (8). That staff-training professionals should have time available for their own training and to assess trainee learning, which is also highlighted (5,8-9,11).

Training centers should maintain a reasonable volume of OAE procedures. In this regard, the ESGE recommends an annual number between 50 and 100 (10). Furthermore, having a fluoroscopy system available is essential. There is no need to master more than one OAE technique, but trainee personnel should be familiar with the operation of all pieces of OAE equipment.

OAE TRAINING CRITERIA AND RECOMMENDATIONS

Over the last few years, ESGE and UEG experts (Small Bowel Working Group) have described a number of performance indicators applicable to the study of the SB, including recommendations for both CE and OAE (10,12). These indicators may be used to implement future OAE training programs.

Required skills before proceeding to OAE

A key factor for successful OAE is an appropriate, stringent indication and patient selection. Hence, a training program should include cognizance of the available

technical and clinical guidelines concerning OAE (13). Another requirement is the knowledge of patient preparation regimens, since adequate preparation is associated with improved bowel mucosa visualization (14). Another relevant training item is the endoscopist's selection of an approach route, which sets OAE apart from other techniques (9). The primary recommendation here is that the route choice should be based on diagnostic procedures, mainly CE, CT or MRI (10). Failure to select the most appropriate route has a negative effect on the diagnostic and therapeutic potential of OAE (10).

Endoscopic estimation and marking

A major aspect of OAE learning is the need to estimate insertion depth, given the absence of clear anatomical landmarks in the SB. For DBE and SBE, such learning occurs during device advancement, whereas this occurs during device withdrawal for OAE. The technique that has proven most accurate was the one described in 2005 by May A et al., which is the only one that has been experimentally validated *in vivo* (15,16). Since there is a great variability and the estimation is highly dependent on the observer, tattooing the point of maximum depth is always necessary. Hence experience in endoscopic tattooing is a training requirement.

Competencies

A point of interest described by experts is a consensus on whether the scheduled therapeutic expectancies were met or the sought-after outcomes were accomplished in at least 80% of cases. This could be used to establish competency in OAE. Another indicator that may be used to assess competency is complication rate, established as ≤ 1 % for diagnostic OAE, ≤ 5 % for therapeutic OAE and ≤ 0.3 % for pancreatitis (10).

Experience in fluoroscopy

Its use is highly advisable during early training, when progression stops after the push-pull maneuvers, in patients with gastric bypass or post-surgical intestinal adhesions or in the presence of bowel strictures. Once the LC has been overcome, its use is merely anecdotal and restricted to endoscopic therapy. Experienced centers report the use of

fluoroscopy in fewer than 10 % of procedures (9,17,18).

DEVICE-ASSISTED ENTEROSCOPY TRAINING. LEARNING CURVES

Unfortunately, there is no validated training model. Scientific societies for digestive endoscopy have described a number of requirements for OAE learning, primarily ESGE and ASGE. However, these are only recommendations due to the absence of scientific evidence (5,10,12).

Several authors have described their learning curves in OAE (Table 2). However, these learning curves are often related to one person or only two endoscopists (3,19-22), which represents a significant limitation. Another issue associated with the assessment of the above learning curves is the lack of consensus on which parameter should be selected for evaluation, such as procedure duration, depth reached in the SB, diagnostic yield, technical success and fluoroscopy time, etc. Mehdizadeh and Gross consider that insertion depth in the SB should be used as a threshold parameter for LC assessment (18,19). However, a more appropriate manner of LC assessment should include technical success, defined as the localization of the findings obtained with preliminary testing (5) (Table 2).

Based on the currently available literature, spiral enteroscopy (SE) seems to require a shorter LC in terms of procedure duration. Although, no data are available for the newer motorized SE. Furthermore, different authors have failed to obtain evidence of an OAE-related LC, whether by the oral or anal route. There is indeed unanimity that the anal route requires more expertise to obtain the correct competency. Anal OAE has even been reported to have a specific LC, independently of oral OAE. Training is focused on expert endoscopists complication rates during the LC, which are very low and there are no differences versus experts in OAE (23). From all the above, the practice needed to acquire the basic competencies necessary to safely and efficiently complete an OAE exploration ranges from 5 to 30 procedures (Table 2).

Regarding training models for OAE, there are very few articles that describe a protocol to obtain the necessary skills for OAE implementation (7,9,15,24,25). A common denominator of such programs is the use of simulators during the initial stages. These are based on the use of porcine GI tracts for the practice of basic maneuvers, including

insertion depth measurement and advancing and correction maneuvers (15,24,25). The use of simulators for training purposes allows endoscopic skills to be acquired, maintained and assessed (11).

The reported models start training with a theoretical module, including the particulars of enteroscopy equipment, then move on to using simulators and finally to witnessing real cases resolved live by experts. Training eventually ends with the trainees managing a number of real-world cases under the mentorship of experts (15,24,25). Schafer et al. propose a training model based on their personal experience. A time-period of usually one day is scheduled for a theory seminar including simulator training. Three enteroscopies, one using the anal route, are specifically required for experienced endoscopists (7).

The longest-standing basic program for the acquisition of OAE skills is the one by Pérez-Cuadrado et al., which has been running uninterruptedly since 2007 and has the most thoroughly defined protocol (24,25). Supervised training starts with the basics required for the development of cognitive skills. It then continues with the use of *ex vivo* porcine simulators (Fig. 1). This phase may be supplemented with the use of animal models under anesthesia, mainly pigs for the oral approach. In the clinical setting, trainees first attend live demonstrations by their mentors as with other training models. They subsequently play a partial role in some procedures under mentor supervision and finally perform their first procedures.

Unfortunately, there is no validated training model for OAE, none allow the assessment of the educational capacity and clinical impact of the various available training protocols (24-29).

CONCLUSIONS

To date, there are no regulated, validated training programs available for OAE. However, various scientific societies have set up task forces to define educational requirements. On the other hand, training should be based on achieving specific levels for the competencies required by OAE rather than on a single LC, as the latter will not ensure an appropriate educational outcome.

According to the variability found among reported data, an experienced endoscopist may perform an OAE procedure in a safe, effective manner after limited training amounting to 5 to 35 procedures, although reaching an expert level requires prolonged clinical practice with exposure to different SB disorders.

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Table 1. Specific maneuvers necessary to learn overtube-assisted enteroscopy

Decision on the insertion route
Attachment of an overtube, balloons (DBE) and manometry system control
Maneuver for the insertion of an endoscope with an overtube
Push-and-pull technique
Operation of manometry systems (double and single balloon)
Anchoring technique using mucosal suction
Clockwise and counterclockwise rotation. Correction
Insertion depth measurement
Fluoroscopic support
Anal insertion technique
Lesion visualization on withdrawal
Unassisted technique

Table 2. Learning curves for device-assisted enteroscopy

Authors (year). Technique	**Oral approach. Procedures**	**Anal approach. Procedures**
Mehdizadeh S (2006). DBE (18)	10	
Mehdizadeh S (2007). DBE (17)		20
Emmett DS (2007). DBE-ERCP (28)	10	
Gross SA (2008). DBE (19)	No LC reported	> 100
Buscaglia JM (2009). DAE (26)	5 *	
Dutta AK (2012). SBE (20)	15	No LC reported

Tee HP (2012). DBE (3)	No LC reported	30-35
Lenz P (2017). SBE (27)	30	
Su MY (2017) (21)	10	5
Kashani A (2018). DBE-ERCP (29)	10	
Chen A (2019). DBE (22)	20	

*Expert endoscopists in DBE or SBE.

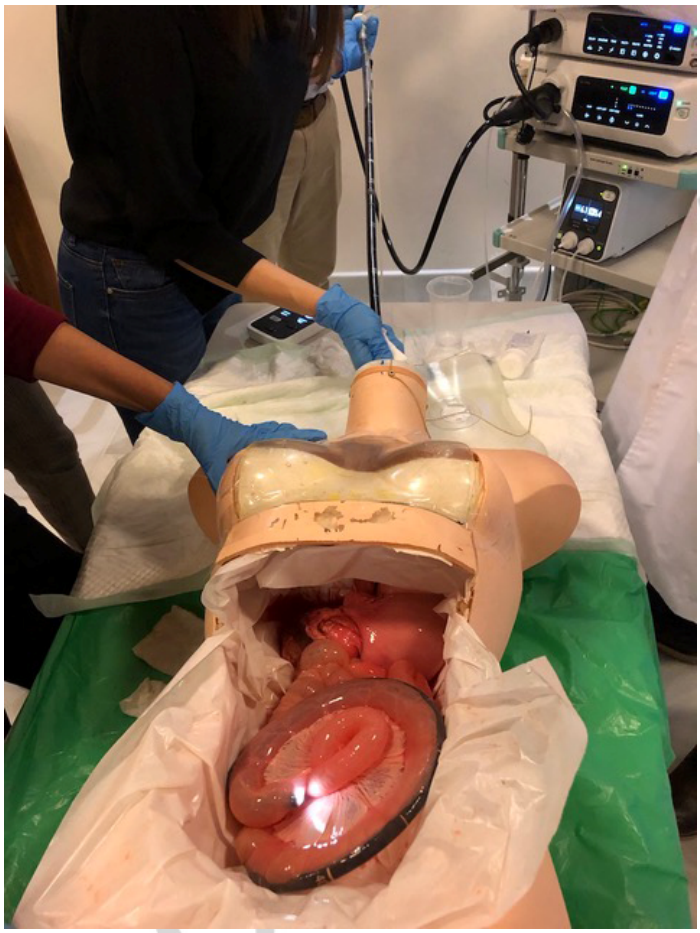

Fig. 1. Enteroscopy training in *ex-vivo* simulator.