Looking forward – what will EUS be doing in 10 years?

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Introduction

It is easy to speculate where a procedure will be in ten years time but the accuracy of such a prediction is always uncertain. It is however, an important mental exercise to consider because training and practice patterns need to evolve in parallel with the procedure and technology. In order to try to predict where EUS will be in ten years time, one needs to consider the strengths and weaknesses of EUS as well as contemplate where gastrointestinal endoscopy in general is moving. Finally, one must consider how competing technologies will evolve over the next decade.

Assessing the strengths of EUS

Some of the strengths of EUS are listed in Table **1**. In my opinion, the greatest current strength of endoscopic ultrasound is its ability to image and sample lymph nodes. This can be important from a diagnostic perspective (evaluation of the patient with enlarged mediastinal lymph nodes) and is also important in staging malignancies. Currently, response to chemoradiotherapy is a relatively crude science based on inaccurate imaging. In the future, as minimally invasive therapies to remove primary tumors evolve (an example is endoscopic mucocsal resection – EMR), the evaluation of lymph nodes will increase in importance. I believe this application of EUS will continue for the foreseeable future and with more sophisticated analysis such as molecular markers for micrometastases evolves, EUS FNA of lymph nodes will gain even greater prominence in clinical practice [1–3]. I do not see any competing technologies for this type of accurate sampling of lymph nodes for the foreseeable future.

Table **1** Strengths and unique assets of EUS

1.	can image small structures – lymph nodes
2.	can sample difficult to access structure
3.	produces unique images of the pancreas
4.	potential for targeted therapy
5.	performed by physicians

I believe that endoscopic ultrasound will continue to play a role in tissue sampling in areas that are difficult to reach by CT scan. These areas include the mediastinum, the uncinate process of the pancreas and the extrahepatic biliary tree. For mediastinal processes, though I believe endoscopic ultrasound will continue to play a significant role, I believe that it is probable that this business will be increasingly taken over by pulmonary physicians. The reason for this is that transesophageal ultrasound of the mediastinum is a relatively simple and safe procedure and therefore can be easily adopted by pulmonologists and thoracic surgeons. There are an insufficient number of gastroenterologists to efficiently manage these cases and the obstacles inherent in cross-referring (patients with pulmonary diseases being referred to gastroenterologists) is too substantial.

A significant growth area for endoscopic ultrasound has been in the evaluation of pancreatic disease. Data continues to be collected suggesting that EUS can accurately diagnose early chronic pancreatitis [4–6] and because of the ubiquitous nature of CT scan, we are seeing more and more cystic lesions of the pancreas [7]. Despite the advent of MRCP (even with secretin stimulation), these images do not match the resolution of EUS. In addition, because difficult pancreatic cases are managed in specialist centers which increasingly integrate EUS in evaluation algorithms, the use of EUS for pancreatic disease will be preserved.

Over the next decade, I think the role of endoscopic ultrasound for therapy will (hopefully) continue to expand. To date, we have not yet seen the emergence of a "killer" therapeutic application.

In terms of injection therapy, I suspect that the utilization of EUS guided celiac neurolysis may well increase. However, this is a palliative therapy for patients with terminal disease and therefore its overall impact is relatively small. Hopefully, more studies will be done on EUS guided celiac blocks, however, this procedure is only of marginal and transient benefit for patients with chronic pancreatitis. I do not think that this procedure will be modified to the extent that it can have a major impact on the pain associated with chronic pancreatitis. There is greater promise in procedures like total pancreatectomy and islet cell reinfu-

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sion as the pain syndrome associated with chronic pancreatitis is too complex to be solved by celiac injection therapy. To date, EUS guided injection therapy for cancer has been disappointing [8]. Trials are ongoing using TNFerade but to date, the results for EUS guided treatment are no better than that produced with CT guided therapy. For any type of EUS intervention to succeed, it must have a clear and measurable benefit over the radiologic approach because the number of CT scanners and radiologists overwhelm the number of advanced endosonographers.

A great deal of enthusiasm and anticipation has surrounded the potential of EUS to guide the creation of digestive anastomosis. This began with Anand Sahai's work in using EUS to create a hepaticogastrostomy [9–10]. Further efforts followed in performing gastrojejunostomy (animals only) [11–14] as well as choledochoduodenostomy [15] and pancreaticogastrostomy [16]. Regrettably, these early efforts have progressed very slowly and none of these procedures are routinely done.

To my view, progress will continue to be very slow for the development of interventional EUS. In part, this is due to the relatively small number of endosonographers capable of embarking on these very sophisticated procedures. The second obstacle is that there is very little incentive by instrument manufacturers to put substantial resources into device development; the market is too small. While EUS guided therapy remains a *potential* strength of endoscopic ultrasound, the current obstacles have prevented this potential from being fully realized. The success of EUS over the next decade however, will in part be dependent upon the development of EUS-guided therapies. For the reasons mentioned, I suspect that it will be a long and arduous road and success will depend on finding therapies that are uniquely delivered by EUS and therefore do not compete head to head with CT, MRI or vascular interventional radiology.

A listed strength for endoscopic ultrasound is the fact that it is performed by physicians. Thus, a high level of patient care is brought to every procedure that is performed. This is a significant strength over "automated" procedures performed by technicians with images interpreted by physicians who have little in depth understanding of the patient.

Weaknesses of endoscopic ultrasound: (Table 2)

The sophistication and complexity of endoscopic ultrasound is a source of both strength and weakness. While it is performed by physicians, it takes considerable training to be expert at all aspects of endosonography particularly EUS-guided FNA and interventions. While physicians performing the procedure likely enhance patient care, it makes the procedure quite expensive and the dissemination of the procedure is limited by the availability of adequately trained physicians. This will continue to be a hindrance in the development of endosonography over the coming decade. Unlike CT and MRI, the procedure cannot be automated and fully standardized. There is an infinite number of unique images that can be generated by endosonography and it requires real-time interpretation. These factors – physician performed examination and inability to automate, will continue to erode its ability to compete with MRI and CT in the imaging market. Over the next decade, endosonography will be overwhelmed by the number of multidetector CT scanners and every improving MRI scanners. It will become easier and easier to generate high-quality images and because they are generated in a standardized digital format, outsourcing of the images for interpretation can be accomplished in a less costly physician environment (such as in India). These factors will cause endoscopic ultrasound to be a "boutique" procedure performed under very specific circumstances based on a finding by CT or MRI which cannot be resolved by these imaging modalities. We are even seeing lymph node evaluation being encroached upon by PET scanning and as this improves, the only remaining niche for EUS will be in tissue sampling.

Table **2** Weaknesses of EUS

1.	performed by physicians
2.	not automated
3.	requires considerable training
4.	significant competition from CT and MRI (and PET?)
5.	expensive

To warrant the cost of a physician driven technology like EUS, it will have to evolve and mature its capability for intervention. Unique therapies to endosonography which demonstrably benefit patients will be an area where EUS can sustain its viability. The key is finding those niches and then developing safe, reliable and relatively simple procedures.

A continuing inhibition to successful progression of EUS over the next decade will be our inability to train a majority of gastroenterology fellows within the context of a three-year training program. Most training programs relegate EUS training to a fourth year of fellowship yet these fourth year positions have no formal and systematic mechanism of funding. Training in EUS involves a patchwork of institutions with the adequate resources and facilities, nurses and trained faculty who are able to provide sufficient numbers of EUS cases to ensure competency. While our data is incomplete, it appears likely that 150 or more carefully supervised examinations are required to achieve competency in both radial and linear endosonography [17]. Under these circumstances, only a minority of the 300 or so fellows in the United States will be trained in EUS. With the requirement for hands-on training to achieve competency, this essentially eliminates gastroenterologists already in practice from fully adopting this technique. It is very difficult to advance a procedure that few physicians perform. Those physicians without the availability of endosonography, will argue vigorously that it is not a necessary procedure in patient care. Healthcare payers, are not very interested in low volume, highly specialized procedures as they have little impact on overall patient care and costs. These factors will severely limit the impact of EUS over the coming decade.

The question then becomes how these obstacles can be overcome. In my opinion, there are several potential solutions:

1. Begin to focus more exclusively on performing EUS with a linear echoendoscope. This is the instrument that will serve as a basic platform for therapeutic intervention.

2. Encourage and support the development, implementation and integration of simulators into EUS training programs to shorten the number of hands-on, supervised examinations required.
3. Strongly encourage all gastroenterology training programs to offer training to the level of competency in endosonography *within a three year curriculum*.
4. Greatly simplify and lower the cost of the technology to encourage its wider adoption.
5. For the United States market, and clearly the most difficult obstacle overcome, is to secure appropriate and fair reimbursement commensurate with the training required and time and intensity that the procedure requires from the physician.

Competition

We continue to see rapid develop within the fields of CT and MRI scanning. There is no reason to believe that this progress will stop. Market factors will continue to lower the cost and increase the quality of these imaging procedures. Combined with competition for outsourcing interpretation of the images, it is logical that these technologies will dominate the field of GI imaging. In light of this, EUS will need to significantly increase the number of physicians capable of performing EUS and will need to refine the application of endosonography to those niche areas in which EUS has unique capabilities which improve patient outcome. Will we be successful? Only time will tell but success or failure will depend on the younger generation of endosonographers as many of us (present author included) will likely be put out to pasture around 2016!

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