

## Role of Linear EUS in GI Diseases

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The widespread use of the linear echoendoscope as the primary and only method for staging as well as performing FNA has been a recent phenomena. In its infancy, the practice of EUS routinely employed a radial exam prior to the intubation of the linear echoendoscope for staging upper GI cancers, submucosal lesions, examination of the pancreas, and for rectal lesions. Although most endosonographers still perform staging exams with the radial echoendoscope, the vast majority of experienced endosonographers rely solely on the linear echoendoscope for interrogating the hepatobiliary and pancreatic regions. Experienced endosonographers would readily admit that it is rarely absolutely necessary to use radial imaging over a linear; a completely obstructing lesion being the exception. In fact, a recent retrospective study specifically compared the use of radial, linear, and miniprobe endosonography equipment during a 10-year prior in a single, large, EUS practice.<sup>1</sup> Scope usage was compared between the first 8 years to the last 2 years. These investigators found the radial echoendoscope to be the predominant scope for luminal cancer staging. However, sole use of the linear echoendoscope was increasing, being the preferred scope for pancreaticobiliary and mediastinal

indications (33% vs. 76%,  $p < 0.001$ ; 46% vs. 96%,  $p < 0.001$ ).

### Oesophageal Cancer

Nearly, all the early seminal studies touting the superior accuracy of EUS for locoregional staging of oesophageal cancer were based on radial staging. Arguments against the routine use of the linear echoendoscope for primary staging cite greater difficulty with image interpretation leading to increased procedure time. This premise was challenged by Simsen et al. who conducted a prospective, randomised study to compare the accuracy of curved array and radial EUS for staging of cancers arising in the oesophagus and cardia.<sup>2</sup> A total of 104 patients underwent EUS; 62 patients had a subsequent surgical exploration. All patients were examined with a radial scanning echoendoscope (UM-3 [first 10 patients], UM-20 [last 94 patients]; Olympus America Corp., Melville, N.Y.) and a curved array scanning echoendoscope (FG32UA; Pentax Precision Instrument Corp., Orangeburg, N.Y.). The high Kappa coefficient for TNM staging accuracy between these two echoendoscopes is consistent with an overall excellent agreement (T, 0.77; N, 0.75; M, 0.89). TNM staging accuracy for the linear and radial echoendoscopes were, respectively, as follows: T, 72 and 73%, N, 70 and 77%; and M, 61 and 57%.

In another study, Matthes et al. compared the 270° transverse array

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endosonography (TA-EUS) with linear EUS (L-EUS) for staging of upper GI malignancy in 43 patients.<sup>3</sup> There was again, excellent agreement on the T stage between the two modalities in 37 of 42 patients (88%). Linear EUS demonstrated 61 abnormal lymph nodes in 26 patients, with an average of 2.3 nodes per patient, whereas radial EUS demonstrated 85 abnormal lymph nodes with an average of 3.3 nodes per patient ( $p = 0.009$ ).<sup>4,5</sup> Interestingly, there was no difference noted in the ease of oesophageal intubation between the two scopes despite a commonly accepted belief that the linear echoendoscope is more challenging to traverse through the upper oesophageal sphincter.<sup>6</sup>

#### **Stomach Cancer**

EUS performs well in the staging accuracy for gastric cancers, although its clinical impact continues to be debated. Early gastric cancers are best visualised with high frequency probes. Comparative studies between the radial and linear echoendoscopes in staging gastric cancer are limited and to a great extent focussed on the cardia. Given this paucity of data, the relative merits of one approach versus the other are largely based on historical controls. The largest cohort of patients undergoing a linear exam for staging of gastric cancer was reported by Shimoyama et al.<sup>7</sup> These investigators performed a routine endoscopy followed by a forward-viewing echoendoscope with a 7.5 MHz linear probe at the distal end (Machida-Toshiba, Tokyo, Japan). Forty five patients with gastric cardia cancer who underwent gastrectomy with at least

a localised lymphadenectomy were retrospectively analysed for staging accuracy with nearly half of the patients harbouring an early stage malignancy. The overall diagnostic accuracy for the depth of invasion was 71%. The sensitivity for T1, T2, and T3 lesions was 100, 31, and 75%, respectively. Mucosal (pT1-m) and submucosal (pT1-sm) cancers were correctly identified in 81% of patients. With FNA as an adjunct to linear imaging, the diagnostic accuracy for lymph node involvement was 80%.

#### **Pancreatic Cancer**

Perhaps in no other disease state has the widespread use of the linear echoendoscope become more apparent than in pancreatic cancer. In addition to vascular staging, the immediate advantage of tissue confirmation is implicit. The ability to perform primary staging, followed by FNA of either the pancreatic mass itself or of lymph nodes, to the ultimate ability to deem the patient as having distant metastasis to organs such as the liver, makes the linear echoendoscope the preferred instrument. The first study performed by Gress et al. utilised a cohort of 79 patients referred with pancreatic cancer.<sup>8</sup> As only 33 patients ultimately had surgical excision, the evaluable groups consisted of 17 patients randomised to linear array and 16 to radial scanning EUS. EUS staging accuracy for linear array was 94% (16 of 17) for T and 71% (12 of 17) for N staging. The staging accuracy for radial scanning was 88% (14 of 16) for T and 75% (12 of 16) for N staging. Surprisingly, radial scanning was more accurate for predicting

vascular invasion 100% (16 of 16) than the linear array 94% (16 of 17). Kochman et al. evaluated the utility of the linear array ultrasound endoscope in the evaluation of suspected pancreatic disease.<sup>9</sup> They prospectively compared the linear probe in 26 patients with suspected pancreatic disease with either surgery or long-term clinical follow-up. With the linear probe, the sensitivity and specificity for malignant disease of the pancreas were 80 and 88.9%, respectively. The sensitivity and specificity of linear array for benign disease of the pancreas were 93.8% and 88.2%, respectively. These investigators similarly concluded that the linear array echoendoscope, when employed solely for evaluating pancreatic diseases, is accurate and would have an even greater benefit with its ability to aid in tissue acquisition

#### **Chronic Pancreatitis and Pancreatic Ductal Anatomy**

Standard criteria for diagnosing chronic pancreatitis are based on well established guidelines using a mechanical radial echoendoscope at 7.5 MHz. Despite standardisation, interobserver agreement between 11 experienced endosonographers blinded to the clinical history who were shown videotapes of both patients with chronic pancreatitis and controls, remains moderate,  $k = 0.45$ .<sup>10</sup> Is a linear array exam able to reliably detect changes of chronic pancreatitis? This question was posed, and unfortunately published only in abstract form.<sup>11</sup> This multicentre study, similarly evaluated the interobserver variability between expert

endosonographers who were shown (but not informed) videotape examinations of the same patient undergoing both a radial and linear echoendoscope. Lai et al. observed similar interobserver variability with a moderate  $k$  coefficient.

Pancreas divisum remains a challenging diagnosis for endosonographers. An early study suggested the possibility of pancreas divisum in patients undergoing a radial examination in whom a "stack sign" could not be obtained.<sup>12</sup> The "stack sign" is an image simultaneously demonstrating the common bile duct, pancreatic duct, and portal vein with the transducer positioned in the duodenal bulb. The overall accuracy for this finding was 80% with a positive predictive value of only 44%. Lai et al. performed a linear-array examination in 162 patients prior to ERCP.<sup>13</sup> They were able to adequately visualise the pancreatic duct in 78% of the patients. The overall prevalence of pancreas divisum was 13.6%. The sensitivity, specificity, and positive and negative predictive values for EUS were 95, 97, 86, and 99%, respectively. The EUS examinations were performed at 5MHz (Pentax FG-32UA, FG-36UX, or EG3630U; Pentax Precision Instruments, Orangeburg, N.Y.). A brief mention of the technique is warranted as their technique is elegant but not yet adequately taught or widely known. The scope is advanced into the second portion of the duodenum until the major papilla is identified sonographically. The balloon is then inflated and the scope withdrawn into a short position similar to that in ERCP. The PD is followed continuously from the

major papilla to the pancreatic body by gentle withdrawal coupled with clockwise rotation. Pancreas divisum was excluded if the duct was either followed continuously from the major papilla to the body or seen crossing the ventral/dorsal border.

### **Common Bile Duct Stones**

EUS has superseded ERCP as the primary endoscopic modality for determining the presence of CBD stones (CBDS); MRCP allows similar accuracy but is limited in stones smaller than 2 mm. Studies in which a radial scanning echoendoscope was used consistently report sensitivities near 90% for the ability of EUS to detect CBDS. Lachter et al. report on 50 patients undergoing a linear array exam (32 FGUA; Pentax, Sci-Lab, Hamburg, Germany) for suspected choledocholithiasis with ERCP serving as the reference.<sup>14</sup> EUS had 97% sensitivity, 77% specificity, and 90% accuracy. The authors conclude that "linear array EUS, despite the learning curve, seems to be about equivalent to radial EUS in accuracy." Another prospective study of 134 patients suspected of CBDS underwent a linear array exam (Pentax FG 32 UA, Tokyo, Japan) followed by ERCP with endoscopic sphincterotomy (127 patients), or choledochoscopy.<sup>15</sup> The accuracy for linear array EUS in determining CBDS was 94%; sensitivity, specificity, positive and negative predictive values were 93, 93, 98 and 87%, respectively.

### **Rectal Cancer**

Literature regarding the sole use of the linear array scope for primary staging of rectal cancer is lacking. Certainly, the

impact of endorectal ultrasound with FNA (RUS-FNA) is widely documented and accepted. Linear echoendoscope can provide acceptable and adequate images for primary staging and is used in cases requiring FNA.

### **Summary**

Performing high quality EUS incorporates both a technical component and an equally important cognitive component. Learning the basics of each component is absolutely vital. This principle is paramount when using the linear array instrument. The basics and "station based" approach will serve as the fundamentals from which one can build the vast library of image recognition with subsequent confidence for performing interventions beyond just FNA. In addition to knowing the images and stations, becoming comfortable with the scope and accessories is crucial. Finally, review of the literature strongly supports the equal merits for the linear echoendoscope in staging primary upper GI cancers and for evaluating both benign and malignant pancreatic diseases.

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### **Management of patients with early mild asthma and infrequent symptoms**

Inhaled glucocorticosteroids (ICS) reduce symptoms and exacerbations in symptomatic mild-to-moderate asthmatics, but whether these drugs prevent fixed airflow limitation is unknown.

Conventionally, guidelines have recommended maintenance treatment with ICS only for patients with frequent symptoms (more than 2 symptom days per week).

In fact, what is the point of placing patients on long-term ICS treatment whose symptoms are defined as infrequent as assessed only in the 2 weeks before trial commencement?

Then, the 3 year treatment with 200-400 µg/day of budesonide would be associated with: marginal reduction of day to day symptoms, reduction of nine SAREs per year in 1000 patients.

Regarding prevention of fixed airflow limitation, it is worth noting that the small protective effect of ICS reported by Reddel and colleagues was derived from the post-hoc analysis of the 3 year part A of the START study, which was powered on SAREs and not on decline of lung function.

Additionally, as appropriately mentioned by Reddel and colleagues, patients should also be offered the alternative as-needed treatment, with a fast-acting bronchodilator and ICS combination and proper training to recognise and promptly treat symptom worsening and exacerbations.

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