**Syllabus for Training in EUS: Domains 1 - 3**

**Domain 1 Novice Phase of Training 0 – 75 cases: Aims of Training**

At induction, if *available*:

- Attend ultrasound and CT lists with HPB/GI/thoracic radiologist
- “Hands off” scope: 50 recommended but 100 is advantageous
- Begin regular attendance at HPB / GI MDT

**Background knowledge of EUS**

Appreciation of indications, reviewing imaging, preparation and equipment checks prior to each procedure (echoendoscope, ultrasound console, monitoring & sedation planning, anticoagulation)

- Contemporary knowledge of local and national guidelines, GMC guidance on consent
- Assessment of “personalized risk” for each patient & potential for adverse events
- Limitations of EUS in comparison to other imaging modalities
- 1x DOPS / 10 cases min for “Hands on” EUS procedures: minimum 7-8 in Novice Phase

**Scope Handling**

- Introduction to oblique viewing linear echoendoscope (radial EUS is optional)
- Agreed Language of Training in Endoscopic Ultrasound within the training unit
  - STOP
  - Pull back (withdraw) and Push in (insert)
  - Blow (insufflate) and Suck (deflate)
  - Clockwise torque and Anti-clockwise torque
  - Tip Up (big wheel down) and Tip down (big wheel up)
  - Tip right (small wheel clockwise torque) and Tip Left (small wheel anti clockwise)
  - Slow down/slowly
- Importance of small movements
- Introduction to ergonomics
  - room set up, table height, console position to the bed, optimal upright posture
  - free umbilical console & endoscopic cables
  - scope positions, scope handling
  - creating good habits at start of training (eg left-hand dominance)
- Intubation of cricopharynx, GOJ, cardia, pylorus, D1/bulb, D2/D3
- Introduction to problem solving when an image cannot be achieved despite following the instructed movements
- Importance of avoiding insufflation, attention on U/S screen rather than Endoscope LCD
Ultrasound Console
Introduction to ultrasound and physics of ultrasound
Introduction to ultrasound console or machine: ultrasound knobology

- Depth penetration
- Zoom
- Transducer Frequency
- Brightness
  - Overall gain control
  - Time Gain Compensation
- Focal Zones
- Dynamic range, Tissue Harmonic imaging
- Basic functions: Freeze and annotation functions, video loop function

Document up to 2 static images per procedure & Introduction to annotation functions

“The Influence of Ultrasound Equipment Knobology in Abdominal Sonography”
https://www.intechopen.com/chapters/65515

Lexicon of Ultrasound Imaging with some examples:

Introduction to the descriptors or language/lexicon of ultrasound reporting. Examples:

**Artefact**: low attenuation, distal enhancement, attenuating, distal acoustic shadowing, dirty shadowing, edge shadowing, ringdown

**Echogenicity**: anechoic, hypoechoic, low level internal echoes, isoechoic, echogenic, hyperechoic, highly echogenic

**Location**: superficial/deep, inferior/superior, lateral/medial, anterior/posterior

**Structure**: size, shape, contour

**Proximity**: abutting, close proximity to, adjacent to, separate from, scattered

**Borders**: well or poorly defined, distinct, indistinct, subtle

**Contour**: smooth, irregular, lobulated, microlobulated

**Masses**: round/spherical, irregular, lobulated, polypoid, crescent shaped, invading

**Mass size**: atrophic, small, normal size, enlarged, hypertrophied, large, organomegaly, swollen, bulky

**Degrees of severity**: trivial, negligible, mild, moderate, severe

**Solid**: homogeneous/heterogeneous, uniformly echogenic, hypo/hyper echoic, smooth, heterogeneous, coarse echotexture, internal nodularity, patchy echotexture, calcified/calcification

**Ducts**: prominent, dilated, ectatic, tortuous, transition points

**Fluid**: free fluid, fluid level, loculated fluid, fluid collections, walled-off, clear, turbid

**Cysts**: unilocular, multilocular, septated, multiseptated, thick/thin, papillary projection

**Vascularity**: avascular, low vascularity (hypovascular, hypoperfused). Isovascular, hypervascular, highly vascular. Perfusion pattern: uniform, non-uniform, regional hypoperfusion

**Effects on surrounding structures**: separate, displacing, indenting, compressing, distorting, protruding, communicating, herniating, invaginating, crossing tissue planes, surrounding, encasing, extending from,
Anatomy encountered at EUS: Introduction to key EUS imaging stations

- Posterior Mediastinum
- Abdominal structures in Stations 1 – IV
  - Station 1: Cardia/OG junction: Liver to Midline and separately Midline to Spleen
  - Station 2: Antrum
  - Station 3: Pyloric canal, D1 / Duodenal bulb
  - Station 4: D2 and D3

Introduction to normal anatomy and to certain structures

- Mediastinum: aorta, oesophageal wall, lymph node stations, cardiac chambers, GOJ
- Abdominal: L lobe liver & hilum, IVC,
- Biliary tree: intra hepatic ducts, common hepatic, cystic duct with GB, common bile duct
- Aorta & origins of CA & SMA, SMV & SV with PV confluence
- Pancreas, main pancreatic duct
- Gastrointestinal wall layer structure
- Spleen, Left and Right kidney, L adrenal

Introduction to pathology

- Mass lesions, benign and malignant tumours, Cystic lesions
- Abnormalities of gastrointestinal wall, GISTs, Leiomyomas
- Vascular abnormalities
- Common bile duct stones, CBD wall thickening
- GB wall abnormalities, GB stones, sludge, microlithiasis
- Appreciation of expected duct calibres, abnormal calibres and transition points

Interpretation of ultrasound Images

- Introduction to use of Ultrasound and Radiological language
- Build up experience of “normal” for multiple structures
- Appreciation of imaging characteristics for:
  - Air
  - Cyst
  - Solid
  - Fluid

The EUS Procedure

- An appreciation of the workflow of running an EUS list
- Introduction to certain aspects of Endoscopic Non-Technical Skills (ENTS)
- Introduction to report writing
Domain 2 Intermediate Phase of Training 76 – 150 case: Aims of Training

Background knowledge of EUS

- Knowledgeable and Competent in pre-procedure preparation: indications etc
  - Ability to distil referrals to ascertain the key clinical question(s)
- Familiarity with assessing previous imaging (U/S, CT, MR, ERCP, EUS etc) and reports
- Knowledgeable on assessment of role of antibiotics
- Proficiency in use of Ultrasound Lexicon and Scope Training Language
- 1x DOPS per 10 cases; minimum 15c total uploaded to JETS around case number 150

Introduction to Remit of the Procedure

- EUS is performed for different indications
- The measurement of Key Performance Indicators (KPIs) is dependent on selecting, and successfully fulfilling, each remit.

Scope Handling

- Knowledgeable on troubleshooting the echoendoscope where problems occur:
  - Electrical connections
  - Valves
  - Air/Water and CO₂
  - Optional: use of the balloon if required
- Adept at with intubation of cricopharynx, GOJ, cardia, pylorus, D1 bulb, D2/D3
- Increasing appreciation of scope handling required to achieve imaging for each station
  - Mediastinum
  - Abdominal Stations I – IV: awareness of the different planes the echoendoscope can adopt within each station
- Ability to manoeuvre scope to optimise images (eg “tip up” to improve coupling)
- Introduction to scope positioning to evaluate sub epithelial lesions in the following:
  - Oesophagus
  - Stomach
  - Pyloric canal and D1 bulb
  - D2 / D3
- Awareness of strategies to hold scope in the correct position for FNA
- Importance of left-hand dominance
- Proficient at avoiding air insufflation and performing small fine movements
Ultrasound Console

Continuing appreciation of ultrasound parameters

- Transducer Frequency, Depth of penetration, Zoom
- Focal Zone, Gain, Time Gain Compensation (TGC), Tissue Harmonic Imaging
- Freeze & Loop function, distance measurement, Store function & transfer to PACS

Increasing knowledge for optimising an image

Capturing and annotation of images: ability to capture 2 to 5 images with annotation

Anatomy encountered at EUS

Introduction to normal anatomy and to certain structures

- Increased recognition of anatomical structure: demonstrated to teacher by pointing
- Wall layer structure of the Gastrointestinal tract (and differences within the oesophagus)
- Increased understanding of vasculature in:
  - Mediastinum and Abdomen eg around pancreas, liver hilum, D2
- Increased exposure to studies examining each station

Increasing awareness of techniques to evaluate

- Whole organ
- Pancreas: uncinate, head and neck, body and tail
- Hepatobiliary tree
- Complexity of the mesenteric vessels

Introduction to pathology

Detection of fluid: Ascites, Pleural effusion, Pancreatic fluid collections

Introduction to tumour staging: Oesophagus, Pancreas, Lymph node assessment, examining for metastatic disease

Characterisation of a tumour: size, shape, echogenicity, vascular Involvement, TNM staging

Evaluation of cysts
Interpretation of ultrasound Images

- Introduction and appreciation of ultrasound artefact
- Introduction to image optimisation
- Use of Doppler to assess vascular structure
- Optional and where available: introduction to contrast

Fine Needle Aspiration (FNA/FNB)

- Introduction to tissue acquisition, FNA/FNAB needle
- Appropriate areas to biopsy
- Different types of needle
- Techniques of FNA & Different suction techniques
- Awareness of the importance of a secure stable position of scope prior to acquisition

The EUS Procedure

- Introduction to report writing. Example:
  - BACKGROUND: imaging results and indication for EUS, Risks
  - REMIT: Type of study
  - FINDINGS: key findings including unexpected ones
  - INTERVENTION: tissue acquisition: needle type, where/how/number of passes, judgement on adequacy for assessment
  - CONCLUSIONS: correlation (or variance) with previous imaging. Findings relevant to clinical care. Assessment of diagnosis and possible differential.
  - RECOMMENDATIONS: further studies or imaging, review in relevant MDT
  - POST PROCEDURAL CARE: recommencement of anticoagulation date/time

- Introduction to certain aspects of Endoscopic Non-Technical Skills (ENTS)
Domain 3 Advanced Phase of training 151 – 250: Aims of Training

Background knowledge of EUS

- Competent in pre procedural work up per case
- Demonstrates regular attendance at HPB / UGI MDT
- Ability to troubleshoot the scope set up

Scope Handling

- Ability to handle the echoendoscope, intubate and navigate in all stations
- Can manoeuvre echo endoscope to optimise an image; (aspiration: left hand dominant)
- Competent in placement of echoendoscope to “follow anatomical structures” consistently
- Consistently controls scope position to record finding and undertake biopsy

Ultrasound Console

- Can troubleshoot and optimise an ultrasound imaging consistently
- Records 7x key annotated static images relevant to each procedure remit

Anatomy encountered at EUS

Normal

- Can appreciate normal and its variants, consistently finds anatomical landmarks
- Proficiency in identifying key structures at each of the stations
- Ability to record challenging anatomical landmarks such as:
  - Mediastinum: AP Window, above aortic arch
  - Station 1: Spleen, splenic hilum, left renal vein, PV confluence, liver hilum
  - Station 2: GB fundus
  - Station 3: Cystic duct, trace bile duct from papilla to hilum and back
  - Station 4: Bifurcation of the aorta, major papilla, Pancreas Divisum

Trainee now moves from appreciation of “static” anatomical stations to manoeuvring the echoendoscope allowing continuous real time ultrasound when examine whole organs, tracing whole vessels & ductal systems and evaluating pathological lesions. The trainee becomes competent in real time U/S with the ability to “Follow the Anatomy”

- Evaluate a whole organ
- Follow vascular or ductal structures along their respective course such as:
  - Descending aorta after the arch
  - Course of the SMA after the origin from aorta
  - Course of the hepatic artery to the liver hilum
  - Trace the bile duct completely from ampulla to liver hilum
  - Trace main pancreatic duct continuously from tail to papilla
- Knowledgeable in appreciation of an incomplete exam, and recognises structures to be avoided during tissue acquisition
Pathology

Ability to detect and assess pathological lesions

- **Stage cancer (TNM):** an appreciation of staging facilitates and consolidates knowledge of anatomical landmarks, pathological lesion assessment & anatomical variants
  - Oesophageal and oesophagogastric cancer
  - Pancreatic cancer
  - Biliary
- **Ability to discern small pathological lesions**
  - Small pancreatic cyst and tumours of 3-5mm
  - Trace of ascites
  - Sub centimetre pathological lymph nodes
  - Characterise and describe pancreatic lesions: NETs, Cysts, IPMN

Interpretation of ultrasound Images

Proficiency in identifying, and documenting in descriptive ultrasound language, studies of different organs

- **Pancreas**
  - Evaluation of normal pancreas
  - Autoimmune disease eg IgG4 related disease involving the pancreas
  - Stigmata of chronic pancreatitis
  - Phases of pancreatitis: inflammatory changes to walled off pancreatic necrosis
  - Ductal calibre changes and transition points
- **Extrahepatic bile duct and ampulla and pathology**
- **GB and abnormalities of structure, presence of pathology**
- **L lobe liver, intra hepatic bile ducts**
- **Optional, where available:** Contrast EUS
  - Indications for routine clinical use:
    - Neuroendocrine tumours and other lesions not appreciated on cross sectional imaging
  - Indeterminate liver lesions in the liver eg haemangioma
  - Cystic lesions with large intra mural nodule

Morphology of lymph nodes
Fine Needle Aspiration (FNA/FNB)

- Competent in undertaking safe tissue acquisition
- Techniques eg fanning
- Awareness of different types of needle suction:
  - vacuum, low suction, water suction, slow pull technique of stylet, no suction
- Excellent knowledge when not to biopsy key structures to avoid doing harm
- Familiarity and confident at tissue bx of sub epithelial lesions when required
- Understanding of differences in tissue preparation of slides for cytology, and preparation for tissue for cytoblock, immunohistochemistry, histology and molecular biology such as flow cytometry
- Ability to prepare slides and preparations for cytoblock and histopathology
- Knowledge of strengths and weaknesses of needle types E.G.
- FNA for solid pancreatic lesions
- FNB for some of the following
  - Lymph nodes
  - Autoimmune pancreatic pathology: IgG4 related disease
  - Sarcoma
  - Lymphoma

The EUS Procedure

- Adequate knowledge in discerning normal findings from pathology
- Consistent in optimising images: scope handling and via ultrasound console
- Ability to carry out an EUS procedure in a suitable time frame whilst also taking charge of the room, communicates with all team members and the patient, demonstrating leadership and ability to make clear decisions
- Competent in Endoscopic Non-Technical Skills
- Consistently creates a structured EUS report
- Documents procedure remit
- Consistently addresses the clinical question (not all questions can be adequately answered)
- Good communication with relevant stakeholders: referring clinicians, MDTs etc