

EFSUMB Common Course

Syllabus Basic Abdominal Course

Introduction

This Syllabus has been discussed in SGUM, OEGUM and DEGUM and was assessed as a good basis for abdominal ultrasound courses. In SGUM/ÖGUM/DEGUM societies, it will be updated every 3 years. It is presented as a basis for joint courses in Europe. We invite all EFSUMB societies to discuss this Syllabus with us. This Syllabus was conceived for all colleagues teaching ultrasound courses and will serve as a common resource and inspiration for other European courses.

In the autumn of 2007, the SGUM decided to reorganize the 3-part course, in accordance with the OEGUM and DEGUM. The basic and advanced courses are the foundation of abdominal ultrasound. The final course may vary, depending on interest and specialization. The course described below is oriented to the needs of general practitioners and internists. In addition, SGUM has prepared a final course for nephrologists, which takes into account their specific needs. Also, courses designed for other specialists interested in the abdomen module are possible. **Each of our course leaders can deepen or modify the proposed content at his/her discretion.**

This Syllabus is only a summary, a common framework, which is designed to assist and inspire tutors and course leaders. This summary includes following parts:

1. **Content of teaching / learning objectives** for each course is presented.
2. **Theoretical knowledge** is listed.
3. **Schedule example** of one of our actual training programs is precisely defined.
4. **Practical exercises** from our basic course will be presented as an appendix.

As mentioned above, this template should not be construed as a rigid schedule but as a tool to help all colleagues who teach and guide ultrasound courses. The Curriculum provides a common platform that will be updated, further developed or extended to meet future needs every 3 years.

In evaluating a candidate from the "abdomen" module, the emphasis lies with the mastery of B- mode examination techniques. In addition, the candidate should have a basic understanding of the application of Doppler technology in the abdomen (including twinkling and jet phenomenon).

1. Content of Teaching / Learning Objectives

Common basic abdominal course

- The graduate should understand the physical principles of ultrasound including Doppler techniques.
- He/she should master the ultrasound anatomy of the abdominal organs and the thyroid.
- He/she will gain practical experience in the operation of the ultrasound device and should know how to use the various features of the device.
- He/she should be able to understand the basics of examination techniques and systematically

examine patients under the supervision of a tutor.

- He/she should understand the principles of e-fast and focused ultrasound.
- He/she should gain practical experience with cases of e-fast and focused ultrasound.

2. Theoretical knowledge

BASIC ABDOMINAL COURSE

Setting:

Total number of hours (1 teaching hour = 45 min): 28-30 hours, of which more than 50% are practical lessons. The optimum number of participants per ultrasound device is 3-4, the maximum is 5. Participants can examine each other. It is optimal when there is one tutor per US device. In practice, there are often two US devices per one tutor but then there must be only 3 participants per US device, which increases the active time of the participants. The participants benefit by gaining a much higher degree of valuable practical experience in their examination technique.

Learning Content:

Technical basics and examinations technique 1:

- Sound frequencies of nature, laws of wave mechanics and optics (reflection, scattering, bending, refraction, absorption, attenuation)
- Generation of ultrasound waves (quartz crystals, special ceramics)
- Piezoelectric effect
- Relationship between frequency and wavelength
- Axial and lateral resolution as well as influence of the wavelength
- Types of ultrasound equipment: A-mode, B-mode, M-mode
- Pulse mode and calculation of depth
- Various probes and its application: linear, convex, sector.
- Attenuation and depth of penetration, influence of wavelength
- Attenuation compensation: Compensation Depth, Time Gain Curve
- Artifacts: posterior shadow, posterior echo enhancement, tangential shadow, reverberations, bow artifact, space-time error, mirroring, blooming, twinkling
- Indication of ultrasonography
- Ultrasonography as a test
 - Pretest probability
 - Sensitivity and Specificity
 - Baye`s Theorem
- Ultrasound as a clinical investigation
 - Study document
 - Supplement the medical history
 - Palpation under ultrasound view
 - Systematic abdominal ultrasound investigation
 - Patient Information

- Patient Preparation
 - sober, non-carbonated drinks, no milk, no coffee
 - No urination before the examination
- Patient Position
 - Supine position
 - Oblique lateral position
 - Prone position
 - Elbow-knee position
 - Standing position
- Report of visual signs in writing
- Sonomorphological assessment criteria
 - Location
 - Size
 - Shape
 - Contour
 - smooth / nodular
 - Echogenicity
 - anechoic / hypoechoic / hyperechoic / complex
 - homogeneous / inhomogeneous / coarsened
 - Architecture

Technical basics - Doppler technique 2:

- Explanation of the mathematical formula and importance of the acoustic angle
- Principle of CW-Doppler
- Frequency-time spectrum (spectral analysis)
- Principle of the pulsed wave Doppler (PW-Doppler)
 - Sample volume, Gate
 - Pulse repetition frequency (PRF)
 - Nyquist theorem (registrable relationship between PRF and maximum frequency shift)
 - Principle of aliasing
- Principle of CDUS (color duplex ultrasound)
- Principle of PWDS (power duplex sonography)

Abdominal Vessels

- Anatomy and ultrasound anatomy:
 - Aorta, CA and its main branches, renal vessels, SMA, IMA, pelvic vessels and their main branches
 - Pelvic veins, vena cava, renal veins, hepatic veins, portal system
 - Lymphatic System
- Normal values: aorta, the definition of the aneurysm and spectral analysis above and below the renal arteries (Vmax, Vmin)
- Normal range (width) in cm, Vmax and Vmin celiac artery (CA), superior mesenteric artery (SMA), inferior mesenteric artery (IMA) and the influence of food intake (SMA)
- Normal values vena cava, venous flow profile
- Normal values portal vein (time average velocity=TAV, portal diameter, flow-volume)

Gallbladder / Bile Ducts

- Anatomy and US-anatomy
 - Location of the gallbladder
 - Relationship bile ducts / portal vein / a. hepatica
- Normal values gallbladder
- Normal values bile ducts

Liver

- Anatomy and US anatomy
- Shape variations
- Vascular supply
- Segmental anatomy

Spleen, Lymph Nodes and Pleura

- Spleen anatomy and US-anatomy
- Normal variants
- Vascular supply
- Normal values spleen size
- Ultrasound anatomy and normal size of lymph nodes
- Examination technique chest / pleura (sitting position)
- Calculation of pleural effusion

Pancreas

- Anatomy and ultrasound anatomy
- Normal variants
- Locations and access, surrounding structures
- SMA, gastroduodenal artery and bile duct
- Relationship to splenic vein
- Representation of the tail of the pancreas through spleen

Kidneys / Adrenals

- Locations of the kidneys and normal variants
- Normal values: thickness of parenchyma, kidney length and kidney volume
- Vascular supply, renal segments and segmental arteries
- Normal values renal vessels (diameter, Vmax, Vmin, RI)
- Locations of the adrenal glands, examination technique

Bladder / Ureter / Prostate / Seminal Vesicles/ Uterus / Adnexa

- Anatomy and ultrasound anatomy of the renal sinus, ureters and bladder
- Urinary obstruction
- Search for stones: twinkling artifact
- Urine jet
- Residual urine, depending on the baseline
- Volume of the bladder: length and depth in the longitudinal, width in the transversal cuts
- Perineal sonography

- Anatomy and US anatomy of the prostate and seminal vesicles
- Normal values for volumes of the prostate
- Measurement in longitudinal section along the urethra and 90 degrees to > width in cross section.
- Anatomy and US anatomy of the uterus and adnexa
- Measurement: uterine length and volume of the ovaries

Neck / Thyroid / Scrotum / Intestine

- Anatomy and US anatomy the SD and the surrounding neck structures, ie vessels, muscles, lymph nodes, salivary glands and tongue / floor of mouth
- Values SD standard volume
- Measurement of intima-media thickness of the common carotid artery (CCA)
- Anatomy of the scrotum and US anatomy
- Anatomy and US anatomy of the intestinal tract

Principles of focused ultrasound

- Clinical Context
- Definition and scope
- Concept

Extended Fast

- Free fluid in the abdomen
- Pleural effusion
- Pneumothorax

Emergency ultrasound- core applications

- Gallstones
- Urinary obstruction
- Abdominal aortic aneurysm
- Deep venous thrombosis

Punctures

- Ascites
- Pleura
- Abscess
- Vessels

Quiz, Course Evaluation

3. Schedule examples

Common basic abdominal ultrasound course

Day One

13.00-13.10: Welcome, introduction

13.10-13.40: Technical Basics and Examinations Technique: Theory

13.40-14.40: Technical Basics and Examinations Technique: Practical examination in groups

14.40-15.10: Doppler ultrasound: Theory
15.10-16.20: Doppler ultrasound: Practical examination in groups
16.20-16.40: Break
16.40-17.00: Abdominal vessels: Theory
17.00-18.00: Abdominal vessels: Practical examination in groups

Day Two

08.00-08.20: Gallbladder / bile ducts: Theory
08.20-09.20: Gallbladder / bile ducts: Practical examination in groups
09.20-09.40: Liver: Theory
09.40-10.00: Break
10.00-11.00: Liver: Practical examination in groups
11.00-11.20: Spleen, lymph nodes and pleura: Theory
11.20-12.20: Spleen, lymph nodes and pleura: Practical examination in groups
12.20-13.30: Lunch
13.30-13.50: Pancreas: Theory
13.50-14.50: Pancreas: Practical examination in groups
14.50-15.10: Kidneys / Adrenals: Theory
15.10-16.10: Kidneys / Adrenals: Practical examination in groups
16.10-16.30: Break
16.30-16.50: Bladder / Ureter/ Prostate / Uterus: Theory
16.50-18.00: Bladder / Ureter/ Prostate / Uterus: Practical examination in groups

Day Three

08.00-08.20: Neck / Intestine: Theory
08.20-09.20: Neck / Intestine: Practical examination in groups
09.20-09.40: Break
09.40-10.00: Principles of focused Ultrasound: Theory
10.00-10.15: Gallbladder Stones: Theory
10.15-10.30: Urinary Obstruction: Theory
10.30-10.45: Abdominal Aneurysm: Theory
10.45-11.00: Deep venous Thrombosis: Theory
11.00-12.30: Practical examination in groups Lunch
12.30-13.30: Lunch
13.30-13.50: E-FAST: Theory
13.50-14.30: E-FAST: Practical examination in groups
14.30-14.50: Punctures: ascites, pleura, abscess: Theory
14.50-15.05: Punctures: vessels: Theory
15.05-16.00: Punctures: vessels: Practical examination in groups (model)
16.00-17.00: Quiz, Course evaluation

4. Practical exercises: Basic Course

Technical Basics 1: practical exercises "Knobology" 1

- Probe selection and frequency selection
- Holding the probe, subcostal cut
- Total gain
- Penetration (field of study: full frame!)
- TGC (sliders series) (CAVE: different behind the bladder!)

- Focus (foci)
- Dynamic Range (DR) variation of the gray values (picture hardness)
- Phototopic Imaging (coloring, optimized contrast)
- Distance and volume measurements

Technical Basics 2: practical exercises " Knobology " 2

- Probe selection, frequency selection for B-mode and Doppler
- Order: first B-mode, then CDUS or PWDS, then spectral curve, if not possible, again the same sequence: B-mode
- CDUS, aorta cuts:
 - Color box: size and location set (as small as possible to keep)
 - Steering of the color field (linear probe)
 - Gain of the doppler signal
 - PRF setting (field scale), setting the max. frequency shift (as a max. calculates speed)
- PW Doppler, setting internal carotid artery:
 - Gate: setting the size and position (2 / 3 of lumen)
 - Steering doppler beam, (linear probe)
 - Gain of the Doppler signal
 - Angle correction (calculation of flow velocity)
 - PRF (or velocity, scale): setting of the maximum frequency shift (as a max. calculates speed)
 - Zero lines shift
- Measurements:
 - Vmax and Vmin (stenosis)
 - RI (nephrology, cancer diagnosis)
 - TAV and volume flow (portal venous flow)

Examination technique: practical exercises

- Patient
 - Positioning
 - Cover with cloth
 - Gel application
- Dealing with the device and ultrasonic probe
 - Setting monitor / screen
 - Subcostal liver: Total gain and TGC
 - Probe: freeze protection
 - Probe position (between the thumb and fingers 2-3, the little finger as a support on the abdomen)
- Exercises
 - Setting an organ in the middle of the screen (wrist tilting)
 - Rotate the probe in place (transverse to longitudinal view and vice versa)
 - Tilting of the probe in place (liver subcostal and intercostal cuts)

Abdominal vessels and lymph nodes: practical exercises

Representation of the proximal aorta with exits in B-mode and CCDS
Representation of the distal aortic bifurcation with branches in B-mode and CCDS
Representation of the iliac artery from bifurcation to inguina in B-mode and CCDS

Gallbladder / biliary tract: practical exercises

Representation and Intercostalschnitt subcostal gall to represent and experiment with the infundibulum, the cystic duct, palpation under visual control
Representation of the portal vein, bile duct, possibly with additional CCDS
Representation of the pancreatic head, bile duct, possibly with additional CCDS
Positioning of patient for better representation of the gallbladder

Liver: practical exercises

Systematically liver representation in longitudinal cuts
Systematically liver representation in subcostal cuts with a fan-shaped technique (including presentation of liver segments)
Presentation of hepatic veins, with CCDS
Representation of portal vein in B-mode systematically, with respect to the segments
Representation of the portal vein with CCDS and PWDS, with portal flow measurement

Spleen / chest / pleura: practical exercises

- Representation of the spleen with measurement of the volume
- Presentation pleura / diaphragm lying with a abdominal curved probe
- Presentation pleura / diaphragm seated, with a abdominal curved probe
- Sitting position: representation of pleura / diaphragm and ribs, including bone-cartilage boundary, with linear probe

Pancreas: practical exercises

- Representation of the pancreas in longitudinal cuts
- Representation of the pancreas in transversal cuts showing the parts: head, uncinate process, body and tail
- Pancreatic duct representation with curved and linear probe, measurement of the pancreatic duct width
- Representation of the pancreatic tail through the spleen
- Representation of pancreas in standing position

Kidneys / adrenals: practical exercises

- Representation in longitudinal section and measuring the length and thickness of kidney parenchyma
- Representation in the short axis measurement of width and depth, kidney volume
- Representation of the adrenal glands in cross cuts (right), and in longitudinal cuts (left)
- Representation of the parenchyma arteries, determination of RI (in the prone position)
- Representation of the renal vessels between aorta and the renal hilus in oblique position, with CDUS
- Representation of the renal vessels at the origin with CDUS and PWDS

Bladder / ureter: practical exercises

- Measurements of bladder volume
- Ureter representation through the bladder wall, "Twinkling"
- Representation of the ureter "Jets"
- Representation of the kidneys in the supine position, with the search of the pyelo-ureteral transition.
- Representation of the crossing point of the ureter with the iliac vessels, with CDUS
- Representation of the kidney in the prone position, with representation of ureter and CDUS and PW Doppler derivation from the subsegmental and arcuate arteries

Prostate / seminal vesicles and uterus / adnexa: practical exercises

- Presentation of prostate, seminal vesicles in the longitudinal and transversal cuts
- Volume measurement of the prostate
- Representation of the uterus, vagina, urethra, in longitudinal and transversal cuts, measurement of uterine length
- Representation of the tubes and ovaries in transversal and longitudinal cuts
- Measuring of the ovarian volume

Thyroid / scrotum / intestine: practical exercises

- Longitudinal and cross-sectional representation of the thyroid, with CDUS
- Thyroid gland volume measurement
- Representation of the salivary glands
- Representation of the carotid artery, lymph nodes, tonsils
- Representation of the terminal ileum, Bauhini`s valve, cecum, appendix
- Representation of the descending colon, sigma

Systematic abdominal ultrasound examination: practical exercises

- Longitudinal cuts: liver with palpation under ultrasound view (liver elasticity)
- Representation of the aorta with branches (also CDUS)
- Transversal cuts: pancreas, choledochus duct in pancreas head
- Intercostal cuts: with portal vein (flow velocity), extrahepatic bile ducts.
- Subcostal cuts: liver, hepatic and portal veins, segments (also CDUS)
- Gallbladder and intrahepatic bile ducts
- Intercostal cuts right: liver, gallbladder, kidney, pleura, diaphragm
- Intercostal cuts left: kidney, spleen, pancreas, pleura, diaphragm
- Infrarenal aorta with branches (CDUS), retroperitoneum, inferior cava vein
- Lower abdomen with longitudinal and transverse cuts: bladder and uterus / vagina / urethra, respectively seminal vesicles, prostate, with volume measurements
- Intestinal representation specifically (cecum, appendix, terminal ileum, sigma, descending colon)

These practical exercises are suggestions, resulting from applied experience. They serve as an orientation and can be specifically tailored to the needs within a group. In the time available all the exercises can either be shown or displayed, selecting a few for indepth investigation and evaluation.

Emergency ultrasound- core applications:

• Gallstones

- Representation gallbladder with gallstones in sagittal/ subcostal and intercostal cuts
- Rolling-Stones by changing patient's position and representation in standing position
- Stones in Knee-Elbow position

• Urinary obstruction

- Representation of obstructed kidney in supine position, ureter
- Representation of obstructed kidney in prone position, ureter
- Ureter and bladder, urinary jets

• Abdominal aortic aneurysm

- Representation of aneurysm in longitudinal and cross cuts
- Measurement of aneurysm diameter
- CDUS of aneurysm

• Deep venous thrombosis

- 2 points compression examination (femoral/ popliteal)
- CDUS femoral/ popliteal

Punctures

- Vessels -model, puncture training

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