



Schweizerische Gesellschaft für Ultraschall in der Medizin  
Società Svizzera di Ultrasonologia in Medicina  
Société Suisse d'Ultrasons en Médecine

# SYLLABUS: ABDOMEN MODULE

## Introduction

This Syllabus has been discussed in SGUM, ÖGUM and DEGUM and was assessed as a good common ground of abdominal ultrasound courses. Hereby we would like to present it as a basis for joint courses in Europe.

This syllabus was conceived for all colleagues teaching ultrasound courses and will serve as a resource and inspiration. The training in the abdomen module consists of a 3-part course (basic, advanced and final courses) comprised of 200 controlled ultrasound examinations and 300 independent ultrasound examinations. A total of at least 400 examinations of the entire abdomen should be performed.

In the autumn of 2007, the SGUM decided to reorganize the 3-part course. In accordance with the ÖGUM and DEGUM, the basic and advanced courses are the foundation of abdominal ultrasound. The final course may vary slightly, depending on interest and specialization. The course described below is oriented to the needs of general practitioners and internists. In addition, we are now prepared to cooperate with interested nephrologists in a final course that takes into account their specific needs. **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. First, the course content of teaching and learning objectives for each course is presented, i.e. what has to be learned to graduate. Second, the theoretical course content ("theoretical knowledge") is listed. Last, the concrete example of a detailed training program (previously completed) is precisely defined.

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 and help to all colleagues who teach and guide ultrasound courses. The syllabus provides a common platform that can always be further developed or extended to meet future course needs.

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).

# **Content of Teaching / Learning Objectives:**

## **Basic Abdomen Course:**

- The graduate should understand the physical principles of ultrasound including Doppler techniques.
- He should master the sono-anatomy of the abdominal organs and the thyroid.
- He will gain practical experience in the operation of the ultrasound device and should know when and how to use the various features of the device.
- He should be able to understand the basics of examination techniques and systematically examine patients under the supervision of a tutor.

## **Advanced Abdomen Course:**

- The graduate becomes familiar with and practiced at identifying the most common and relevant diseases of the liver, gallbladder and bile ducts, spleen, pancreas, retroperitoneum, kidneys and adrenal glands, urinary tract and the internal genitalia.
- He should be able to apply the examination techniques (including CCDUS) to the major abdominal disorders.
- Under the supervision of a tutor and independently, he is able to gather further practical experience.

## **Final Abdomen Course, General / Internal Medicine:**

- The graduate should learn the most common and relevant diseases of the gastrointestinal tract, the abdominal wall, lungs and pleura, the deep veins of the legs, scrotum, thyroid gland, the superficial lymph nodes and other soft tissues (hematoma, muscle tears etc.).
- He should be able to practically apply the examination techniques (including FKDS) for the major diseases of the gastrointestinal tract, the abdominal wall, pleura and lung, the deep veins of the legs, scrotum, thyroid, lymph nodes and other soft tissue.
- He is to independently integrate all practical experiences.

## **Final Abdomen Course, Nephrology:**

- The graduate should deepen his knowledge of the diseases of the kidneys and adrenal glands, the urinary tract, including evaluation of the renal arteries, the transplanted kidney and the hemodialysis shunts.
- He should be able to practically apply the examination techniques (including renal biopsy, CCDUS and spectral curves) to the major diseases of the kidneys, adrenals, urinary tract, transplants and A / V fistula.
- He is to independently integrate all practical experiences.

# BASIC COURSE

## Setting:

Total number of hours: 21, of which more than 50% are practical lessons. The maximum number of participants per ultrasound device is 4. Participants examine each other. It is optimal when there is one tutor per US-device. In practice, there are often more US-devices and only 2-3 participants rather than 4 per US-device, which increases the active time of the participants. After many years of experience we have agreed to about 6 hours theory and 15 hours of practical exercises. The participants benefit by gaining a much higher degree of valuable practical experience in their examination technique.

## Learning Content:

### Technical Basics 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

### Technical Basics 2:

#### Doppler technics

- Explanation of the mathematical formula
- 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 CCDUS (color coded duplex ultrasound)
- Principle of PWDUS (power duplex ultrasound)

## Examination Technique:

- 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 visually and in writing
- Sonomorphological assessment criteria
  - Location
  - Size
  - Shape
  - Contour
    - smooth / nodular
  - Echogenicity
    - anechoic / hypoechoic / hyperechoic / complex
    - homogeneous / inhomogeneous / coarsened
  - Architecture

## Abdominal Vessels and Lymph Nodes:

- Anatomy and sono-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)
- Sono-anatomy lymph node (quotient length / width > 2; hilus, cortex)

### **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 / Chest / Pleura:**

- Anatomy and US-anatomy
- Normal variants
- Vascular supply
- Normal values spleen size
- Examination technique chest / pleura (sitting)
- Calculation of pleural effusion

### **Pancreas:**

- Anatomy and sono-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:**

- Anatomy and sono-anatomy of the renal sinus, ureters and bladder
- Urinary obstruction
- Search of stones: twinkling artefact
- 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

### **Prostate / Seminal Vesicles and Uterus / Adnexa:**

- 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

### **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 carotis artery (CCA)
- Anatomy of the scrotum and US-anatomy
- Anatomy and US-anatomy of the intestinal tract

### **Quiz, Course Evaluation.**

## **Example of a Detailed Program:**

### **Basic Abdominal Ultrasound Course**

#### **Thursday**

- 13.00-13.15: Welcome, introduction
- 13.15-13.45: Technical Basics: Theory
- 13.45-14.45: Technical Basics: Practical examination in groups
- 14.45-15.15: Doppler ultrasound: theory
- 15.15-16.00: Doppler ultrasound: Practical examination in groups
- 16.00-16.30: Break
- 16.30-17.00: Analysis Technique: Theory
- 17.00-18.00: Analysis Technique: Practical examination in groups

#### **Friday**

- 08.30-09.00: Abdominal vessels and lymph nodes: Theory
- 09.00-10.00: Abdominal vessels and lymph nodes: Practical examination in groups
- 10.00-10.30: Break
- 10.30-10.45: Gallbladder / bile ducts: theory
- 10.45-12.00: Gallbladder / bile ducts: Practical examination in groups
- 12.00-13.00: Lunch
- 13.00-13.30: Liver: Theory
- 13.30-14.45: Liver: Practical examination in groups
- 14.45-15.00: Spleen / pleura: Theory
- 15.00-15.30: Spleen / pleura: Practical examination in groups
- 15.30-16.00: Break
- 16.00-16.15: Pancreas: Theory
- 16.15-17.30: Pancreas: Practical examination in groups

#### **Saturday**

- 08.00-08.30: Kidneys / Adrenals: Theory
- 08.30-09.45: Kidneys / Adrenals: Practical examination in groups
- 09.35-10.15: Break
- 10.15-10.30: Bladder / Ureter: Theory
- 10.30-11.45: Bladder / Ureter: Practical examination in groups
- 11.45-12.00: Prostate / seminal Vesicles and Uterus / Adnexa: Theory
- 12.00-13.00: Lunch
- 13.00-14.00: Prostate / seminal Vesicles, Uterus / Adnexa: Practical examination in groups
- 14.00-14.30: Thyroid / Testes / Intestine: Theory
- 14.30-15.30: Thyroid / Intestine: Practical examination in groups
- 15.30-17.00: Systematic abdominal US examination: Practical examination in groups
- 17.00-17.30: Quiz, Course evaluation.

# ADVANCED COURSE

## Setting:

Total number of hours: 16, of which more than 50% are practical lessons. The maximum number of participants per ultrasound device is 4. There is also one tutor per each US-device. The practical exercises with patients should be performed in one-hour sequences. To allow for a more varied practical experience, the groups should be rotated every 30 minutes. An examination period less than 30 minutes brings with it unnecessary rush and the feeling of having insufficient time for the investigation. A clear division of participants into their respective groups helps them focus more intensely and precisely on the work.

## Learning Content:

### Repetition of Systematic Abdominal Examination: Demonstration

- Longitudinal cuts of the liver: US-device customization
- Scanning and palpation of left liver segments under ultrasound view, clinical “elastography”
- Representation of the aorta, celiac trunk, AMS, both renal arteries (CCDUS)
- Cross cuts with pancreas, representation of bile duct in head of the pancreas
- Portal vein and extrahepatic bile ducts.
- Subcostal cuts of the liver, with systematic scanning technic, hepatic veins with CCDUS
- Gallbladder and intrahepatic bile ducts
- Right intercostal cuts: liver / gallbladder, kidney with measurement, pleural
- Intercostal view: left kidney and spleen, pancreas tail, pleura
- Infrarenal aorta with branches (CCDUS), pelvic vessels, inferior vena cava
- Lower abdominal longitudinal and transverse bladder and uterus / vagina / urethra, respectively. seminal vesicles, prostate volume measurements
- Intestinal representation specifically (cecum / appendix / terminal ileum, sigma / descending colon)

### Gallbladder and Bile Ducts:

- Cholecystolithiasis
- Sludge
- Acute cholecystitis
- Cholesterolosis
- Gallbladder polyps
- Gallbladder carcinoma
- Intra-and extrahepatic cholestasis
- Choledocholithiasis
- Caroli's disease and other biliary cystoid changes
- Pneumobilia
- Cholangiocarcinoma (Klatskin tumor)

### **Liver Disease Part 1: Diffuse Disease:**

- Fatty liver disease, including severity levels 1-3.
- Inhomogeneous focal steatosis or non-steatosis
- Acute lesions (hepatitis, intoxication, congestion)
- Chronic hepatitis
- Fibrosis, including hereditary forms
- Budd-Chiari Syndrome
- Forms of cirrhosis (alcohol, primary biliary, virus hepatitis B and C, Wilson`s disease, hereditary hemochromatosis)
- Portal venous flow measurement for various diseases

### **Liver Disease Part 2: Focal Changes:**

- Anechoic changes
  - Liver cysts
  - Cystic hydatid
  - Cyst Liver
  - Vascular anomalies
  - Bile duct anomalies
- Hypoechoic changes
  - Hematoma
  - Abscesses
  - Focal non-steatosis
  - Metastases
  - Adenomas
  - Focal nodular hyperplasia (FNH)
  - Hepatocellular carcinoma (HCC)
- Hyperechoic changes
  - Hemangiomas
  - Focal steatosis
  - Metastases
  - Calcifications

### **Pancreas:**

- Acute pancreatitis
- Chronic pancreatitis
- Cystic pancreatic changes
- Pancreatic cancer

### **Aorta, Inferior Vena Cava, Retroperitoneum, Spleen:**

- Aorta and its main branches, iliac arteries
- Vena Cava and other abdominal veins (excl. portal vein)

- Other changes in the retroperitoneum
- Retroperitoneal spaces, acute (inflammatory) changes
- Retroperitoneal Fibrosis
- Changes of lymphnodes
- Spleen:
  - Splenomegaly
  - Spleen injuries
  - Splenic infarction
  - Focal changes

### **Kidneys Part 1: Diffuse Disease**

- Disease associated with large kidneys
  - Acute Glomerulonephritis
  - Acute interstitial Nephritis
  - Acute Pyelonephritis
  - Amyloidosis
- Disease associated with small kidneys
  - Chronic Glomerulonephritis
  - Chronic Pyelonephritis
  - Analgetic Nephropathy
- Renal vascular disease
  - Renal artery stenosis
  - Renal vein thrombosis

### **Kidneys Part 2: Focal Changes and Adrenals:**

- Anechoic Changes
  - Renal cysts
  - Polycystic kidney disease
  - Cystic renal cell carcinoma (RCC)
- Hypoechoic changes
  - Renal adenoma / Oncocytoma
  - RCC
  - Focal pyelonephritis / Abscess
- Hyperechoic changes
  - Angiomyolipoma
  - Focal pyelonephritis
- Changes in the adrenals
  - Anechoic changes
    - Adrenal cysts and cystadenomas
    - Adrenal bleeding
  - Hypoechoic changes
    - Adrenal adenoma / Incidentaloma
    - Pheochromocytoma
    - Metastasis / Lymphoma

- Hyperechoic changes
  - Myelolipoma
- Perirenal changes
  - Hematoma
  - Abscesses
  - Infiltrates of Lymphoma
  - Liposarcoma

### **Urinary tract, Bladder:**

- Renal sinus changes
  - Anechoic
    - Hydronephrosis
    - Reflux
    - Renal Vein Width
    - Ampullary pelvis
    - Megapolykalikose
    - Parapelvic cysts
  - Hypoechoic
    - Renal Pelvic Tumors
    - Bleeding / Hematoma
  - Hyperechoic
    - Stones
    - Tbc
    - Calcium Milk
    - Vascular Calcification
- Ureter and Bladder Changes
  - Residual urine
  - Urine Jet
  - Stones
  - Bladder Outlet Obstruction and Diverticulum
  - Bladder cancer

### **Uterus and Andexa; Prostate:**

- Uterus disease
  - Myoma and Leiomyosarcoma
  - Endometrial thickening, including Endometrial Carcinoma
- Adnexal disease
  - Salpingitis
  - Cystic Changes
  - Ovarian Cyst
  - Polycystic Ovaries
  - Ovarian Kystoma
  - Ovarian Cancer
  - EUG

- Prostate
  - Benign Prostatic Hyperplasia (BPH)
  - Prostatic Cysts
  - Prostatitis
  - Prostate Cancer

**Quiz, Course Evaluation.**

## **Example of a Detailed Program:**

### **Advanced Abdominal Ultrasound Course**

#### **Day 1 (Friday):**

08.00-08.15 Introduction  
08.15-08.45 Systematic abdominal ultrasound examination: Demonstration  
08.45-09.45 Practical examination in groups  
09.45-10.00 Break  
10.00-10.30 Gallbladder and Bile Ducts  
10.30-11.30 Practical examination in groups  
11.30-12.00 Liver Disease Part 1: Diffuse Disease  
12.00-13.30 Lunch  
13.30-14.30 Practical examination in groups  
14.30-15.00 Liver Disease Part 2: Focal Changes  
15.00-16.00 Practical examination in groups  
16.00-16.30 Break  
16.30-17.00 Pancreatic Disease  
17.00-18.00 Practical examination in groups

#### **Day 2 (Saturday):**

08.00-08.15 "wake-up" Quiz (repetition of the previous day)  
08.15-08.45 Aorta, vena cava, retroperitoneum, spleen  
08.45-09.45 Practical examination in groups  
09.45-10.00 Break  
10.00-10.30 kidneys, adrenals, Part 1: Diffuse Disease  
10.30-11.30 Practical examination in groups  
11.30-12.00 Kidneys, Adrenals, Part 2: Focal Disease  
12.00-13.30 Lunch  
13.30-14.30 Practical examination in groups  
14.30-15.00 Urinary system, bladder, prostate  
15.00-16.00 Practical examination in groups  
16.00-16.30 Break  
16.30-17.00 Uterus, Ovaries  
17.00-18.00 Practical examination in groups  
18.00-18.30 Quiz, Course Evaluation

# FINAL COURSE

## Setting:

Total number of hours: 16, of which more than 50% are practical lessons. The maximum number of participants per ultrasound device is 4. There is one tutor per each US-device. The practical exercises with patients should be performed in one-hour sequences. To allow for a more varied practical experience, the groups should be rotated every 30 minutes. An examination period less than 30 minutes brings with it unnecessary rush and the feeling of having insufficient time for the investigation. A clear division of participants into their respective groups helps them focus more intensely and precisely on the work.

## Learning Content:

### **Repetition of ultrasound examination: intestine, neck, abdominal wall, thorax: demonstration**

- Systematic investigation intestine (linear probe)
  - Stomach
  - Small Intestine
  - Terminal ileum
  - Appendix
  - Ascending, transverse, descending colon
- Systematic neck examination (linear probe)
  - Thyroid transversal cuts
  - Thyroid longitudinal cuts
  - Thyroid volume measurement (convex probe)
  - Thyroid CCDUS examination
  - Salivary glands: eq. submandibular / sublingual and parotid gland
  - Search lymphnodes: along carotid artery to jaw angle, and sternocleidomastoideus muscle
  - Representation of the tonsils in the angle of the jaw
  - Measurements of intima media thickness (IMT) in the common carotid artery, formation of plaques
- Systematic examination of the chest (convex and linear probe)
  - Sitting position, dorsal, lateral ventral cuts
  - Lying position, oblique cuts (diaphragm)
- Systematic abdominal wall examination (linear probe)
  - Lying position, checking abdominal wall layer for hernia and other abnormalities
  - Inguinal region lying + standing, check with palpation, valsalva maneuver and cough under ultrasound control view
  - Location of the inferior epigastric artery (delineation of direct and indirect inguinal hernia) and the femoral vessels (medial to it femoral hernia search)

## **Gastrointestinal System:**

- Stomach changes
  - Pyloric stenosis
  - Gastric retention
  - Gastric ulcer
  - Gastric lymphoma
  - Stomach cancer
  - Rare tumors (leiomyoma, sarcoma)
- Small bowel changes
  - Acute gastroenteritis
  - Sprue
  - Small bowel obstruction
- Changes in the right lower abdomen
  - Appendicitis
  - Right side diverticulitis
  - Ileocolitis
  - Crohn's disease
- Changes in the left abdomen
  - Diverticulitis
  - Ulcerative colitis
- Further changes
  - Intestinal cancer
  - Intestinal lymphoma
  - Intestinal bleeding
  - Ileus
  - Ileopsoas muscle syndrome
  - Peritonitis
  - Peritoneal carcinosis

## **Changes in the abdominal wall:**

- Hernias
  - Inguinal hernias
  - Femoral hernia
  - Spiegel 's hernia
  - Incisional hernia
- Other abdominal wall lesions
  - Cicatricial changes
  - Hematoma
  - Inflammatory lesions (abscesses)
  - Tumours (lipomas)
  - Metastases
  - Bypass circulation in liver cirrhosis

### **Changes in lymph nodes and scrotum:**

- Lymph node changes
  - Reactive
  - Lymphoma
  - Metastases
- Scrotal changes
  - Anechoic changes
    - Hydrocele
    - Seroma
    - Spermatocele
    - Testicular cyst
    - Varicocele
  - Hypoechoic changes
    - Scrotal hematoma
    - Scrotal edema
    - Testicular torsion
    - Testicular rupture
    - Epididymitis
    - Orchitis
    - Testicular abscess
    - Testicular tumours
    - Seminoma
  - Echorich and complex changes
    - Testicular calcifications
    - Microlithiasis
    - Dystrophic calcification
    - Corpus librum
    - Calcified testicular atrophy
    - Epidermoid cyst

### **Thyroid and other neck organs:**

- Diffuse thyroid changes
  - Pyramidal lobe
  - Aplasia, hypoplasia
  - Diffuse goiter
  - Basedow's Goiter
  - Thyroiditis
    - Acute thyroiditis
    - Subacute thyreoiditis de Quervain
    - Hashimoto's thyroiditis
- Focal thyroid changes
  - Multinodal Goiter (MNG)
  - Hyperechoic node
  - Hypoechoic nodes

- Microfollicular adenoma
    - Papillary carcinoma
  - Rare changes
- Changes in the salivary glands
  - Inflammatory changes
  - Warthin tumour
  - Pleomorphic adenoma
  - Rare changes
- Carotid artery: intima media thickness
  - Correct measurement
  - Importance of the intima media thickness
  - Plaques

## **Chest**

- Rib changes
  - Rib fracture
  - Rib metastases
- Chest wall lesions
  - Lipoma
  - Metastases
- Pleural changes
  - Pleural effusion
    - Transudate
    - Exudate
  - Pleurisy
    - Tbc
    - Pleural carcinosis
  - Pleural Mesothelioma
- Peripheral pulmonary consolidation
  - Pneumonia
  - Carcinoma
  - Pulmonary
  - Pulmonary infarction
  - Atelectasis
- Mediastinum
- Aortic aneurysms (ascending aorta, aortic arch)

## **Diagnosis of deep vein thrombosis (DVT):**

- Anatomy of leg veins
- Examination technique of leg veins under inclusion of CCDUS
- Physical examination and laboratory testing in DVT
- Ultrasound findings in DVT
- Ultrasound findings in deep venous insufficiency

### **Diagnosis of other soft tissue changes:**

- Hematoma
- Edema
- Muscle tear
- Abscess
- Perianalfistel
- Sakraldermoid
- Baker`s cyst and other ganglions
- Subcutaneous and musculoskeletal tumours

### **Ultrasound examination: Report, photographic documentation, billing**

- Country specific lectures

**Contrast enhanced Ultrasound (CEUS):** This is an optional lecture, which can be replaced by the deepening of the above topics or another topic. One might also demonstrate complex cases with the inclusion of CEUS. Subsequent practical examinations can be conducted, such as viewing and evaluating especially rare or interesting cases.

## **Example of a training program:**

### **Final Course Program Abdomen:**

#### **Day 1 (Friday):**

08.00-08.15 Introduction

08.15-08.45 Examination technique: intestine, neck, thorax, abdominal wall: demonstration

08.45-09.45 Practical investigations

09.45-10.00 Break

10.00-10.30 Bowel disease

10.30-11.30 Practical investigations

11.30-12.00 abdominal wall, hernia

12.00-13.30 Lunch

13.30-14.30 Practical investigations

14.30-15.00 Lymph node changes, scrotum

15.00-16.00 Practical investigations

16.00-16.30 Break

16.30-17.00 Thyroid, neck

17.00-18.00 Practical investigations

#### **Day 2 (Saturday):**

08.00-08.15 Wake-up Quiz (repetition of the previous day)

08.15-08.45 Chest

08.45-09.45 Practical investigations

09.45-10.00 Break

10.00-10.30 Diagnosis of deep vein thrombosis

10.30-11.30 Practical investigations

11.30-12.00 Soft tissue changes

12.00-13.30 Lunch

13.30-14.30 Practical investigations

14.30-15.00 CEUS options

15.00-16.00 Practical investigations

16.00-16.30 Break

16.30-17.00 Report, photographic documentation, billing

17.00-18.00 Quiz, course evaluation

## Appendix: Basic Practical Exercises

### 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 CCDUS or PWDUS, then spectral curve, if not possible, again the same sequence: B-mode ...
- CCDUS, 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 CDUS
- Representation of the distal aortic bifurcation with branches in B-mode and CDDUS
- Representation of the iliac artery from bifurcation to inguina in B-mode and CDDUS

### **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 CCDUS
- Representation of the pancreatic head, bile duct, possibly with additional CCDUS
- 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 CCDUS
- Representation of portal vein in B-mode systematically, with respect to the segments
- Representation of the portal vein with CCDUS and PWDUS, 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, uncinete 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 CCDUS
- Representation of the renal vessels at the origin with CCDUS and PWDUS

### **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 CCDUS
- Representation of the kidney in the prone position, with representation of ureter and CCDUS 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 CCDUS.
- 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 CDDUS)
- 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 CDDUS)
- Gall bladder and intrahepatic bile ducts
- Intercostal cuts right: liver, gallbladder, kidney, pleura, diaphragm
- Intercostal cuts left: kidney, spleen, pancreas, pleura, diaphragm
- Infrarenal aorta with branches (CCDUS), 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 years of 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 in depth investigation and evaluation.

Uster, Switzerland, November 30, 2009

Jan Tuma, MD, ass. prof.