These distinct features in tumor growth, secretory capacity and localisation are consequently reflected in the wide variation in clinical presentation of different NETs. Moreover, a number of NETs may be found incidentally when patients undergo surgery for unrelated reasons or may be an unexpected finding in the histopathological specimen as with appendiceal carcinoids. Accordingly, the need for diagnostic procedures and the choice of imaging methods varies considerably depending on the patient’s tumor status at presentation.

The various aspects to consider in the choice of imaging methods are related to primary tumor detection, evaluation of its local extent and relation to adjacent anatomical structures, staging of the tumor concerning regional and distant metastases, evaluation of tumor somatostatin receptor density, therapy monitoring and detection of recurrent disease. In this review, the various applications of current radiological modalities are described, including computed tomography (CT), magnetic resonance imaging (MRI), ultrasonography (US), contrast-enhanced US (CEUS), endoscopic US (EUS) and intraoperative US (IOUS). The corresponding applications of nuclear medicine procedures are presented separately.
Materials and Methods

The participants of the consensus meeting considered the use of various radiological methods for the different imaging applications in relation to documented available figures on sensitivity and specificity together with the expertise of the participants; availability of the various modalities was also taken into account. Further aspects considered were patient preparation and information, clinical information communicated to the radiologist for optimisation of the examination procedure and imaging interpretation, imaging protocols, reporting of results and radiation dose administered to the patient. The use of intravenous (i.v.) contrast media (CM) for CT in patients with impaired renal function and in subjects with previous experience of side effects by i.v. CM was also addressed.

In general, data from the literature regarding the sensitivity and specificity of the various radiological modalities used for the diagnosis of NETs suffer from the small number of patients included and the absence of a reliable gold standard for verification of the imaging results. Quite frequently, detection rate is reported instead of sensitivity and specificity. Results are sometimes based on a patient-by-patient analysis and in other reports the results are also, or instead, lesion-by-lesion based. The detection rate merely states the proportion of patients with disease that is detected by the imaging method out of all examined subjects. The sensitivity is instead calculated with reference to a gold standard and equals the proportion of patients with the disease detected by the imaging method out of all patients with the disease according to the gold standard [sensitivity = true positive observations/(true positive observations + false negative observations)]. This review includes imaging data on sensitivity and specificity on a patient-by-patient basis. Detection rates are instead based on lesion-by-lesion analyses and report the proportion positive imaging results in patients with biochemically/clinically evident NETs. Also, the studies that were considered used current standards of imaging. Thus, studies in which incremental CT was performed, those without adequate contrast enhancement, and studies that utilised low field strength MRI (<0.5 T) were excluded.

The current presentation, on radiological imaging of NETs, was adapted to the layout of the template for the whole consensus document and is divided into paragraphs according to the various radiological imaging techniques.

Results

Computed Tomography

Modern spiral or helical CT, generally multidetector CT (MDCT) scanners are available in most radiology departments and CT has currently replaced several imaging applications for which earlier other imaging modalities were employed, such as plain film radiography and angiography. By utilising several parallel detector rows, in recent generations of CT scanners at least 64 detector rows and with a tube rotation time of 0.3–0.5 s, hundreds or more of 1-mm or sub-millimetre transaxial images are acquired per second and the whole abdomen and thorax may be examined during one breath hold. These thin, detailed images may be reformatted in any chosen anatomical plane, usually in coronal and sagittal views. The images allow reconstruction in three-dimensional (3D) volumes and can be rotated to better appreciate anatomy and pathological findings. Importantly, as opposed to previous incremental CT scanning, the development of the fast MDCT technique allows considerably better use of i.v. CM and CT imaging can now be performed in several contrast-enhancement phases, i.e. early arterial (or CT angiography), the late arterial (or portal-venous inflow) and the venous contrast-enhancement phase. MDCT has therefore developed as one of the basic techniques for oncological imaging including NETs.

Sensitivity, Specificity and Detection Rate

The CT-acquired sensitivity, specificity and detection rate (mean and range based on the number of patients and studies) for various NETs is presented in table 1.

In 5 studies on 162 patients, CT showed a mean 73% (range 63–82%) sensitivity and 96% (range 83–100%) specificity for diagnosing an EPT [1–5]. The mean detection rate for EPTs of a further 6 studies including 178 patients was 73% (range 39–94%) [6–11]. Based on these 11 studies that included 343 EPT patients the mean sensitivity and detection rate for an EPT was 73%, although with a considerably wide variation (39–94%), but a generally high specificity (mean 96%).

In 4 studies reporting on the detection of NET liver metastases in 135 patients the mean sensitivity was 82% (range 78–100%) whereas the mean specificity was 92% range (83–100%) [12–15]. In a single study including 21 patients, the detection rate was 81% [11]. Four studies evaluating the presence of extrahepatic soft tissue metastases in 77 patients showed a 75% mean sensitivity (range 63–90%) and 99% specificity (98–100%) [12–15]. Another similar study on 21 patients reported 81% detection rate [15]. Three reports on imaging of various NET metastases in the abdomen and thorax included 164 patients and showed a mean sensitivity of 83% (range 61–100%) and specificity of 76% (range 71–80%) [13, 16, 17]. The detection rate in a similar study including 25 patients was 76% [11].

CT enteroclysis showed a 50% sensitivity and 25% specificity in 8 patients with NETs compared to capsule endoscopy where the corresponding figures were 38 and 100%, respectively [18]. In 219 patients with small bowel tumors, CT enteroclysis showed a sensitivity and specificity of 85 and 97%, respectively, and 19 of these tumors were carcinoids [19].
Hard- and Software Requirements

For CT of the abdomen, thorax and neck, the CT scanner should allow spiral examinations, optimally by MDCT, and should be able to reconstruct at a minimum $\leq 3$-mm and optimally $\leq 1$-mm images. The high spatial resolution of the thin slices is needed for optimal examination especially of the pancreas, liver and neck. A high temporal resolution is also needed in order to perform examinations during contrast enhancement for abdominal CT angiography, and the various contrast-enhancement phases required for proper examination of the liver and pancreas.

The software needed for image reconstruction and image reformats for multiplanar reconstructed images and maximum intensity projections are generally supplied with the CT scanner but specialised image reformating with volume rendering technique and virtual endoscopy may need additional software programs.

Patient Information

For better patient cooperation and examination results, the patient should be well informed and properly prepared. Patients should receive information accordingly; the examination generally takes $<15$ min. For abdominal CT, patients need to arrive at the department $2$ h in advance for filling of the bowel by drinking up to $800$ ml of fluid (generally tap water). Then patients are placed on the examination bed and moved into a short tunnel, i.e. the CT gantry, where claustrophobic patients may become symptomatic and should be adequately prepared with diazepam. When CM administration is required via an i.v. catheter, this may lead to a feeling of warmth. The presence of a previous history of renal impairment and i.v. CM-related adverse reactions, whether this was systemic or localised, should be checked. In the presence of previous adverse effects the contrast material responsible should be investigated since side effects experienced with older ionic high-osmolar preparations are rare with modern non-ionic and low-osmolar CM.

Fluids but no solid food are recommended during $12$ h before the examination. In patients with impaired renal function it is of particular importance to inform the patient that he or she needs to be well-hydrated before the examination in order to reduce the risk of CM-related renal adverse effects.

Information on the radiation dose is generally not necessary for the patient. It should be documented on the imaging report, according to local regulatory authorities.

Patient Preparation

Patients who have experienced a severe CM-related reaction by modern non-ionic and low-osmolar CM are pretreated with oral antihistaminic drugs and glucocorticoids according to local expertise. Medications should start $13$–$16$ h before the contrast-enhanced CT examination; for urgent procedures the i.v. route is preferred.

Also, the type of CM responsible for a previous or current CM-related reaction should, if this information is available, be documented in the radiological report. Further use of this particular CM may then be avoided since

<table>
<thead>
<tr>
<th>Type of NET</th>
<th>Sensitivity mean (range)</th>
<th>Specificity mean (range)</th>
<th>Detection rate mean (range)</th>
<th>Number of patients/studies</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Endocrine pancreatic tumor</td>
<td>$73% (63–82)$</td>
<td>$96% (83–100)$</td>
<td>$73% (39–94)$</td>
<td>$162/5$</td>
<td>1–5</td>
</tr>
<tr>
<td>Liver metastases</td>
<td>$82% (78–100)$</td>
<td>$92% (83–100)$</td>
<td>$81%$</td>
<td>$135/4$</td>
<td>12–15</td>
</tr>
<tr>
<td>Extrahepatic abdominal soft tissue metastases</td>
<td>$75% (63–90)$</td>
<td>$99% (98–100)$</td>
<td>$81%$</td>
<td>$77/4$</td>
<td>12–15</td>
</tr>
<tr>
<td>Various NET lesions in abdomen and thorax</td>
<td>$83% (61–100)$</td>
<td>$76% (71–80)$</td>
<td>$76%$</td>
<td>$164/3$</td>
<td>13, 16, 17</td>
</tr>
<tr>
<td>Small bowel NET at CT enteroclysis</td>
<td>$50%$</td>
<td>$25%$</td>
<td>$85%$</td>
<td>$19%$</td>
<td>18</td>
</tr>
</tbody>
</table>

Data in the literature on the sensitivity, specificity and detection rate for NET diagnosis by CT.

* Out of 219 patients included in the study there were 19 subjects with carcinoids.
the CM-related side effect is related to the specific CM molecule, and not to iodine in general.

Diabetic patients treated with metformin should stop the drug the day before, or at the latest, the same day as the CM administration and have serum creatinine checked before restarting metformin. Although serum creatinine is routinely used, it should be interpreted with caution in the elderly and smaller patients; in such cases creatinine clearance can be used instead (normally >40 ml/min). A serum creatinine ≥130 μmol/l puts patients at risk for renal impairment; in such cases hydration with at least 1 litre of fluid before and after CM is administered. When serum creatinine is >180 μmol/l, CT examination is generally performed without i.v. contrast enhancement.

As an aid, various computer software is available to make an estimation of the creatinine clearance by using the patient’s serum creatinine, weight, age and sex as input parameters according to the formula:

\[
\text{Estimated creatinine clearance} = \frac{[k \times (140 – \text{age}) \times \text{weight in kg}] / \text{serum creatinine in μmol/l}},
\]

where k is a constant which is 1.23 for men and 1.04 for women [20].

Data on the possible benefits of i.v. iodixanol as a CM in patients with renal impairment is not convincing.

For filling of the bowel, patients generally drink 800 ml of tap water during 2 h before the CT examination of the abdomen. About 20 ml of CM (300–400 mg/ml) may be added to the tap water. However, for CT examination of the pancreas or when duodenal disease is suspected, the duodenum needs to be filled with water without addition of CM. This is best achieved when the patient drinks the last 150–200 ml of water a few minutes before CT examination. It is usually sufficient to start filling of the bowel an hour before CT of the upper abdomen and the water volume may be reduced to 400 ml. Administration of an anticholinergic agent (e.g. butylscopolamine 20 mg i.v.) to reduce bowel motility is optional.

For abdominal CT of the small bowel, CT enteroclysis, the filling of the bowel requires a larger volume, approximately 1.5 litres of water. The patient can drink the water during 1 h before the examination or it can be administered through a naso-gastro-jejunal tube. By using a dedicated (150 ml/min rate) power injector, optimal filling of the whole small bowel may be achieved during enteroclysis. CT enteroclysis can also be performed during i.v. contrast enhancement.

CT of the colon requires i.v. contrast enhancement and is performed after cleaning the bowel and insufflating air or CO₂ as for CT examination for suspected colonic carcinoma.

**Information Is Provided by the Clinician**

In order to perform a proper CT examination and to decrease potential risks, it is necessary that the clinician provide adequate information. This includes the precise diagnosis, current medical therapy, previous surgery, and information regarding the presence of diabetes, renal impairment and previous CM-related adverse reactions. The results of previous imaging examinations are mandatory.

**Imaging Technique**

The imaging protocols used for CT of the abdomen, including the liver and pancreas, thorax and neck vary according to the local experience and routines. Given that the previously recommended hardware requirements are taken into consideration and that bolus-tracking technique is available, various examination protocols usually result in equally good examinations. Consequently, this consensus document is focused on basic examination parameters, instead of detailed protocols, and important general imaging aspects are discussed.

Currently, MDCT of the abdomen, thorax and neck is performed using 4 × 2.5- to 64 × 0.6-mm detectors in 4- and 64-channel MDCT scanners, respectively. A pitch of 1.25–1.5 is recommended. The pitch is the table movement per tube rotation divided by the width of the total number of the detectors used. The resulting 1- to 3-mm transaxial images should preferably be reformatted in 2- to 3-mm multiplanar reconstructed images, the coronal and the sagittal planes using a 1/3 to 1/2 overlap to facilitate reading and especially image presentation at clinical conferences.

Intravenous CM is administered given that the patient’s renal function is considered. For i.v. contrast enhancement of the abdomen, 1.5–2 ml/kg body weight (maximum 180 ml) 300–350 mg/ml non-ionic low- or iso-osmolar contrast material should be used at 3–5 ml/s injection rate, using a power injector. The use of a dual syringe injector is recommended by which a 40-ml injection of physiological saline can be administered immediately after the CM injection. This assures that the whole CM volume is utilised for contrast-enhancement purposes and it decreases the otherwise undesirably high CM concentration in the brachiocephalic vein and the superior vena cava.

CT angiography and examination of the liver and pancreas is preferably performed using bolus-tracking tech-
nique. When this is not available, the approximate examination start for CT angiography is 15–25 s, portal-venous inflow phase (also called the late arterial phase) 25–30 s and venous phase (also called portal, or portal-venous phase) 70–90 s after CM injection start. CT angiography may be needed in the preoperative setting, but usually the examination in the portal-venous inflow phase is sufficient to evaluate the anatomy of the arteries and their relation to the tumors. Also, the portal-venous inflow phase is in most cases sufficient for EPT diagnosis, and examination in the so-called pancreatic phase (at approximately 40 s after CM injection start), which is advocated for CT of ductal pancreatic carcinoma, is generally not as advantageous for EPT imaging.

For proper examination of the liver, a sufficient amount of iodine must be injected in order to achieve adequate enhancement of the normal liver in the venous contrast-enhancement phase to optimise delineation of the poorly vascularised metastases. A high CM injection rate, at least 3–5 ml/s, results in proper enhancement of the aorta and the larger arteries for CT angiography. A similarly high i.v. CM influx is needed for enhancement of well-vascularised liver metastases in the portal-venous inflow phase and to achieve adequate enhancement of the pancreas and renal parenchyma. Also, a high CM injection rate allows a better separation over time between the various contrast-enhancement phases.

For CT enteroclysis, a naso-jejunal tube is placed downstream to the Treitz ligament, and 2 litres of warmed tap water are administered preferably by using a pump at 150–200 ml/min. Intravenous glucagon or anticholinergic drug is recommended and CT scanning is then performed during i.v. contrast enhancement 50 s after injection of 120–150 ml at 3 ml/s. Because small lesions are anticipated, reconstruction of thin, approximately 2 mm, sections are recommended and viewing using multiplanar reconstructions and cine loop is mandatory.

When the thorax and/or the neck is examined together with the abdomen, the amount of CM and the injection rates are adjusted to what is required to perform a proper CT of the abdomen. When the thorax and/or the neck, by contrast, are examined separately, the amount of CM injected and the injection rate can be decreased. MDCT of the neck also requires a somewhat lower CM injection rate: approximately 1.5–2 ml/kg body weight of CM is recommended to be injected at 2.5 ml/s and using a 40-s scanning delay. For CT examination of the thorax, even less CM and a lower injection rate can be used. Approximately 1–1.5 ml/kg body weight of CM is administered at about 1.5 ml/s and a scanning delay of 60 s is preferable.

For CT of the liver, a so-called three-phasic examination is required. This involves examination before (non-enhanced, native) and during i.v. contrast enhancement in the portal-venous inflow and in the venous phase. For follow-up of NET liver metastases, some restrict CT examination to the venous contrast-enhancement phase and only when the initial imaging work-up has shown better delineation of the liver metastases in the non-enhanced examination and/or in the portal-venous inflow phase one or both of these phases are added. This routine is, however, insufficient since there is a risk that new well-vascularised metastases may escape detection. Also, fatty infiltration of the liver, which may be initiated by medical therapy, can significantly change the imaging prerequisites. Liver metastases initially diagnosed during the venous phase may no longer be visible at follow-up, but show up in the non-enhanced examination and/or the portal-venous contrast-enhancement phase. The risk of misinterpreting areas of normal parenchyma in a fatty infiltrated liver as metastases is also reduced by using three-phasic CT examination. Moreover, characterisation of an adrenal incidentaloma may be performed when a pre-contrast examination is also included.

Coordination of CT scanning in relation to the CM injection is best controlled by using the ‘bolus-tracking’ technique, for which computer software is regularly supplied together with the CT scanner. This allows monitoring of the aortic enhancement during contrast medium administration in order to determine the optimum time point for the examination start. Various routines also exist in the use of the bolus-tracking technique. For CT angiography and examination in the portal-venous contrast-enhancement phase a fixed attenuation value (around 150 Hounsfield units, HU) in the abdominal aorta may be used to initiate the scanning start. As an alternative, a lower value (around 100 HU) may be used to trigger the examination start but needs to be followed by a 10–15-s scan delay. In combined CT examinations of the abdomen and thorax, including three-phasic CT of the liver, the order that scanning of these body regions is performed depends on how the bolus-tracking technique is applied. Initially non-enhanced scanning of the liver is generally performed. Then the liver is examined in the portal-venous inflow phase and thereafter the thorax and abdomen in the venous phase. Alternatively, an examination of the thorax early after CM injection start is favored and coordinated so that the subsequent scanning of the liver is performed in the portal-venous inflow phase, and thereafter the whole abdomen is examined in the venous phase.
Radiation Dose

The radiation dose administered to the patient varies with the examination protocol and the type of CT scanner. A high tube voltage and tube current, a long tube rotation time and a low pitch increase the dose. In order to maintain a proper image quality in large-size patients, the tube current is increased. This may be decreased in small-size patients. This results in a higher radiation dose to large-size compared to small-size patients. With a MDCT scanner with few channels, the relatively narrow package of detectors needs to be rotated more times in order to scan the patient than in an MDCT scanner with additional channels and a wider detector package. With each tube rotation, the so-called penumbra zone of radiation at the cranial and caudal edges of the detector package adds to the radiation dose, consequently resulting in a higher dose to the patient in the former case.

An examination in a 16-channel MDCT scanner 16 × 1 mm (‘one run’) of a patient of 70 kg results in an approximate radiation dose of 6 mSv for the whole abdomen and 4 mSv for the upper abdomen (liver) from the diaphragm to the iliac crest. An optimal MDCT examination of the abdomen comprising three-phasic CT of the liver and examination of the pelvis in this 70-kg patient thus results in a 14-mSv radiation dose. Corresponding figures for MDCT of the thorax is 3.5 mSv and of the neck 4.5 mSv. By comparison, the resulting radiation dose is approximately 1/4 higher when using a 4-channel MDCT scanner (4 × 2.5 mm).

Image Findings

Gastric, duodenal, rectal and colonic NETs are diagnosed by endoscopy. The role of CT in these cases is to detect regional and distant metastases for staging of the disease.

For type 1 and type 2 gastric carcinoids, CT is not required except for large (>2 cm) and invasive tumors detected by EUS. Type 1 tumors are predominantly located in the fundus and body of the stomach and are typically multicentric, <1 cm in diameter, rounded with sharp margin and contrast-enhancing. Type 2 gastric carcinoids are usually multiple and located within the stomach wall which is thickened secondary to gastrin hypersecretion.

Type 3 gastric carcinoids are solitary, large lesions, with a more irregular and more diffusely delineated margin that may ulcerate. These tumors can also extend into the fat surrounding the stomach (fig. 1).

Duodenal NETs are usually small contrast-enhancing tumors and in the case of gastrinomas may be multiple. For CT diagnosis of the primary tumor it is important to distend the duodenum with water and to perform the examination during i.v. contrast enhancement since this will facilitate detection of the usually markedly contrast-enhancing tumor which is depicted against the low attenuating water in the bowel lumen.

Functional EPTs are typically small, sharply delineated and can be multiple in patients with the MEN-1 syndrome. These tumors tend to be best visualised as evenly contrast-enhancing tumors in the portal-venous inflow phase (at approximately 30 s) rather than in the pancreatic contrast-enhancement phase (at approximately 40 s after CM injection start). In the venous contrast-enhancement phase, EPTs usually exhibit higher attenuation than the surrounding normal pancreas.

Non-functioning EPTs are usually larger and may have calcifications that are best depicted in the non-contrast-enhanced examination. Larger EPTs are usually not as well vascularised and may comprise areas of necrosis; contrast enhancement is not as pronounced and usually shows an irregular pattern. CT also delineates the position of the tumor in relation to the pancreatic and common bile duct, evaluates possible vascular encasement and stages the disease with respect to regional lymph node involvement and presence of distant metastases, mainly to the liver. Larger EPTs can be confused with ductal pancreatic cancers. However, with a usually slowly growing EPT occluding the pancreatic duct, this is dilated proximal to the occlusion and the surrounding pan-
creatic parenchyma is severely atrophic and appears like a thin brim surrounding the dilated duct.

The small bowel carcinoids are mostly found in the ileum rather than in the jejunum and are usually small and occasionally multiple. Consequently, these small tumors are difficult to diagnose as filling defects at CT enteroclysis (fig. 2). With the use of a positive (e.g., diluted barium sulphate solution) oral CM the usually high attenuating carcinoid is more likely to escape detection than when the lesion is surrounded by a low attenuating oral CM such as water, similarly to what was previously discussed regarding diagnosis of duodenal tumors.

Frequently, midgut carcinoids present as mesenteric metastasis (fig. 2). These can induce an intense desmoplastic reaction causing contraction and tethering of the adjacent bowel loop resulting in partial or complete intestinal obstruction. Vascular encasement of the superior mesenteric artery and vein may compromise bowel circulation. At CT, this is reflected as an irregular soft tissue mass, typically with one or several areas of calcifications, surrounded by radiating streaks in the mesenteric fat resembling spokes in a wheel. The superior mesenteric artery and/or vein or branches/tributaries of these vessels may be encased by the tumor.

For NETs of the colon and the rectum, the role of CT is not to detect the primary tumor or to appreciate its invasion of the rectal wall, the surrounding mesorectum and adjacent organs which instead is most likely better performed by MRI or US. Colonic NETs are generally diagnosed by colonoscopy and fluoroscopy, and CT is therefore utilised to stage rectal and colonic NETs by detecting regional and distant metastases.

CT cannot differentiate liver metastases due to NETs from any other malignant tumors. Generally, NET liver metastases are well vascularised and best depicted during i.v. contrast enhancement in the portal-venous inflow phase where they show up as high attenuating lesions in the non-enhanced normal liver (fig. 3). Poorly vascularised NET liver metastases are, however, also frequent. These are best depicted in the venous contrast-enhancement phase as low attenuating areas relative to the normal contrast-enhanced high attenuating liver parenchyma. Larger metastases are fairly often visible in the pre-contrast images in which occasional areas of calcification are best seen. Peripheral contrast enhancement and central necroses in larger NET liver metastases are often seen.

Viewing of the CT examination should always be performed using window settings optimised for image reading of soft tissues, lung and bone, respectively. For liver and pancreas it is necessary to adjust the window setting and decrease the window width and to increase the window centre (level) in the contrast-enhanced images to optimise lesion detection.

The CT appearance of NET lymph node metastases is similar to those from other malignant tumors, although a marked contrast enhancement is frequent. However, some particular anatomical sites should be kept in mind during image reading. Besides in the mesentery and in the retroperitoneum, lymph node metastases from midgut carcinoids can often be found ventrally in the lower thorax adjacent to the thoracic wall and to the heart (fig. 4). Also, retrocrural lymph node metastases are not infrequent (fig. 5) as well as subcutaneous and breast metastases (fig. 6) from midgut carcinoids. When evaluating the CT examination for lymph node metastases, in anatomical regions where these may be surrounded by fat, it is often helpful to adjust the window setting by increasing the window width to facilitate lesion detection. Also, the use of multiplanar reconstructed images is advantageous for depiction of small lymph node metastases. Peritoneal carcinosis is occasionally seen, most often in the ventral aspect of the abdomen (fig. 7).

Lung metastases from NETs, similarly to those from other malignant tumors, appear as rounded, usually multiple and generally well-delineated soft tissue opacities. NET bone metastases are often sclerotic (blastic), but can be osteolytic and sometimes show a mixed appearance.
Documentation and Reporting of Results

For research, the RECIST (Response Evaluation Criteria in Solid Tumours) criteria are regularly used as the reference standard by which tumor response to treatment is reported and these criteria are therefore advantageous when comparing the results of different trials. However, in the daily clinical routine, the WHO (World Health Organisation) criteria are usually applied. Measurable lesions should exceed 1 cm largest diameter. Necrotic or confluent lesions should not be measured. Bone metastases, pleural fluid, ascites, peritoneal carcinosis and leptomeningeal disease are non-measurable lesions. Except for the quantitative description of the measurable lesion sizes and the sum of products or lengths, according to the WHO and RECIST criteria, respectively, also a qualitative description of the tumors regarding treatment response, e.g. necrosis, should be reported. The contrast-enhancement phase in which the lesions are best depicted should be reported. In order to accurately communicate the diagnostic information, liaison between radiologists and clinicians is essential.

Fig. 3. a Transaxial CT image during i.v. contrast enhancement in the portal-venous inflow phase of several well-vascularised midgut carcinoid liver metastases. b In the venous phase the metastases are no longer discernible.

Fig. 4. Transaxial CT image during i.v. contrast enhancement in the venous phase of two retrocrural midgut carcinoid lymph node metastases (arrows).

Fig. 5. Transaxial CT image during i.v. contrast enhancement in the venous phase of two metastases in the right thorax in front of and behind the inferior vena cava, respectively (arrows).
Magnetic Resonance Imaging

Sensitivity, Specificity and Detection Rates

The number of studies on MRI in NET patients is even smaller compared to CT. The MRI-acquired sensitivity, specificity and detection rate (mean and range based on the number of patients and studies) for NETs at various anatomical sites is presented in Table 2.

In 2 studies on MRI for detection of EPT, a fairly large number of 54 patients were included and a mean 93% (85–100%) sensitivity and 88% (75–100%) specificity was obtained [21, 22]. An even larger number of 192 patients were included in 5 studies showing a mean 73% (range 50–94%) detection rate for EPT [6, 9, 11, 23, 24].

Diagnosis of NET liver metastases was evaluated in 3 trials including 74 patients resulting in an overall mean 82% (range 80–85%) detection rate [11, 15, 23]. In a direct comparison of MRI with somatostatin receptor scintigraphy and CT in 64 patients, MRI detected 95% of liver metastases [25].

Extrahepatic abdominal soft tissue metastases were evaluated in 34 patients showing a sensitivity and speci-
ficity of 89 and 100%, respectively [15]. In 2 studies on 58 patients a mean detection rate of 68% (range 55–81%) was obtained [11, 23].

**Hard- and Software Requirements**

The development of MRI over the last few years has resulted in increased field strengths; with current standards an MR scanner with a field strength of 1.5 T or higher should be used. The use of a phased array torso coil is recommended.

The scanner should allow examination with at least 3 mm and not more than 5 mm thick sections. The ability to use fast acquisitions in 3D during one breath hold is recommended to decrease or eliminate respiratory image artefacts and facilitate the use of i.v. CM. Fat-suppressed sequences are recommended to increase tissue contrast. The image quality for various MRI sequences may, however, vary between scanners from different vendors and with the field strength. For MRI of the pancreas, MR cholangiopancreatography (MRCP) should be available to visualise the pancreatic duct and detect any duct obstruction.

**Patient Information and Preparation**

In general, the presence of magnetic metal implants and pacemakers is considered a contraindication for performing MRI. Patients should be asked about any previous metal implant procedures so that the material can be checked against a list of procedures, available at MRI departments, that precludes an MRI examination.

The problem with claustrophobia is more pronounced with MRI than CT and the patient should be informed that during the examination he or she will be placed in a long tunnel and will have to remain still during the approximately 30 min of the examination. If the patient is claustrophobic, administration of diazepam may be necessary. During the examination there will be a loud cracking sound in the scanner that will require earplugs. When CM needs to be administered, i.v. access is obtained and before some examinations, e.g. of the small bowel, the patient needs to be at the department an hour in advance for filling of the bowel. Before MRI of the pancreas, filling of the stomach and duodenum with paramagnetic fluid is advantageous to decrease image artefacts that may impair the image quality, especially of MRCP.

The patient’s history should be checked for diabetes and renal impairment, and the risk for nephrogenic systemic fibrosis, which may be associated with the use of gadolinium (Gd) CM in patients with chronic renal failure, should be observed when Gd-contrast enhancement is considered.

**Information Provided by the Clinician**

In order to optimise the MRI performance and decrease the risks from the examination procedure, the referring physician needs to provide information regarding patient’s diagnosis, medical therapy, previous surgery, kind of surgery and the findings at surgery and results of previous imaging examinations. Information regarding the presence of diabetes, renal impairment (risk of nephrogenic systemic fibrosis) and magnetic metal implants are mandatory. Please see also pertinent parts in the corresponding paragraph regarding CT.

**Examination Technique**

In order to optimise image quality, the field of view should be kept as small as possible and the thinnest sections available should be chosen. No slice gap should be used if it can be avoided. In contrast to CT, i.v. administration of an anti-peristaltic drug (e.g. butylscopolamine 20 mg i.v.) is recommended to optimise MRI examination of the pancreas and bowel.

MRI is generally not optimal for thorough examination of extended body areas. In order to allow for a high-quality MRI, including all proper sequences and dynamic imaging during i.v. contrast enhancement, only a limited part of the body can be examined within a reasonable period of time. In addition to this fact and due to the generally more limited availability of MRI compared to CT, MRI is best used as a ‘problem-solving tool’. It can be applied when there is strong suspicion for a NET not documented by other imaging modalities and when the results of these are equivocal or contradicting. Conversely, if extended body areas are included, there is usually no time to apply the most optimal technique and the examination needs to be performed with thicker sections, fewer sequences and without applying proper contrast-enhancement techniques.

The MRI sequences that are generally recommended for the detection of NETs are fat-saturated transaxial T1-weighted (if available water selected) and fat-saturated T2-weighted sequences (if available spectral inversion recovery SPIR) and optionally fat-saturated transaxial in and out of phase T1-weighted sequences. For MRI of the pancreas, MRCP should also be performed by coronal radiated T2-weighted thick slice (25 mm) radiated sequences with two ranges including the pancreatobiliary junction and the pancreatic body, respectively, to better evaluate the regional anatomy and the relation of the EPT to the pancreatic duct and the main bile duct. T2 thin slices MRCP with 3D acquisition is also accurate.
Short breath-hold sequences are recommended when ‘moving targets’ such as liver, pancreas and bowel are examined. Transaxial dynamic Gd contrast-enhanced MRI should be applied. This involves acquisition at 30, 70 and 120 s and at 3–5 min after injection start. 3D acquisitions are recommended, particularly for dynamic examinations, which can be reconstructed in various anatomical planes and not only to produce transaxial sections.

The conventional extracellular Gd-based MRI CM, with a pharmacokinetic pattern similar to that of iodine CM used for CT, remains the standard for i.v. contrast-enhanced MRI. Liver-specific i.v. CM for characterisation of liver lesions are optional.

Some Gd chelates (Gd-DTPA, Gd-EOB-DTPA) immediately after injection act as extracellular contrast agents but are not eliminated with glomerular filtration. Instead they accumulate in the hepatocytes during a relatively long period of time following injection (approximately 15–120 min depending on the chelate) and thereby make tumor tissue appear hypointense. Mn-DPDP is a manganese-based hepatocyte-specific contrast agent that retains a strong paramagnetic effect approximately 15 min to 4 h following injection producing an increased signal in the normal liver parenchyma. Mn-DPDP may also be used for MRI of the pancreas.

Superparamagnetic iron oxide particles are composed of iron oxide crystals coated with dextran or carboxydextran and are taken up by the Kupffer cells but are not retained in tumor tissue. The particles induce strong relaxation effects in the normal liver parenchyma, which becomes hypointense, while tumors appear hyperintense relative to the liver parenchyma, thereby increasing tissue contrast.

Image Findings

At MRI, a NET appears typically as a low signal lesion in T1- and a high signal lesion in T2-weighted images. The MRI appearances of NETs are similar to those of CT concerning tumor delineation, contrast-enhancement characteristics and various morphologic patterns. Although spatial resolution is poorer with MRI than CT, the better soft tissue contrast of MRI facilitates the detection of small NETs.

Detection of small EPTs is favorable with MRI (fig. 8), particularly with T1 water selected and T2 SPIR thin slices. EPT typically is not associated with main pancreatic duct stenosis and upstream enlargement (fig. 8), and this fact is particularly underlined by the findings at MRCP.

Depiction of small liver metastases is also favorable by MRI using these signal sequences and lesions that are equivocal or contradictory at CT and CEUS may better be characterised by using the various MRI sequences and should also include dynamic examination with i.v. CM.

Although EPT liver metastases commonly show very high signal intensities on T2-weighted images, making their distinction from cavernous haemangioma difficult, Gd-enhanced hepatic arterial dominant-phase imaging facilitates their differentiation. Thus, liver metastases regularly show heterogeneous intense enhancement while a haemangioma during the arterial dominant contrast-enhancement phase typically displays globular peripheral skip enhancement. In the haemangioma the contrast enhancement will subsequently gradually extend towards the lesion center, and during the late contrast-enhancement phase a complete filling of the haemangioma is regularly seen. The haemangioma will then appear hyperintense compared to the normal liver whereas the washout of the CM from a liver metastasis regularly will make the lesion appear relatively hypointense [26]. Danet et al. [27], who evaluated MR imaging findings on 512 metastatic lesions in 165 patients with NETs, reported that ring enhancement was observed in 72% of patients during the hepatic arterial dominant phase. Peripheral low intensity area signs were observed in the post-contrast late phase, and perilesional enhancement in the portal-venous phase was found in 92% of hypovascular metastases.

Fig. 8. Coronal T2-weighted MR image showing a hypersignalling EPT in the pancreatic head (arrowhead). The common bile duct can be clearly delineated (arrow) and is not compromised by the tumor.
Fig. 9. Sagittal T1-weighted MR image of the spine showing hypointense midgut carcinoid bone metastases most evident in the vertebral bodies of thoracic vertebra 10 and lumbar vertebrae 3 and 5.

Fig. 10. Transaxial MR image of the brain during i.v. Gd contrast enhancement in the venous dominant phase showing contrast-enhancing cerebellar metastases (arrows) from a midgut carcinoid.

Table 3. US, EUS, IOUS and CEUS diagnosis of NETs

<table>
<thead>
<tr>
<th>Type of NET and US method</th>
<th>Sensitivity mean (range)</th>
<th>Specificity mean (range)</th>
<th>Detection rate mean (range)</th>
<th>Number of patients/studies</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Endocrine pancreatic tumor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>US</td>
<td>39% (17–79)</td>
<td>153/6</td>
<td>28–33</td>
<td>28–33</td>
<td></td>
</tr>
<tr>
<td>EUS</td>
<td>90% (77–100)</td>
<td>261/10</td>
<td>10, 29–31, 33–38</td>
<td>39</td>
<td></td>
</tr>
<tr>
<td>IOUS</td>
<td>93%</td>
<td>75/1</td>
<td>28, 31, 40, 41</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insulinoma</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EUS</td>
<td>92% (88–94)</td>
<td>86/4</td>
<td>10, 30, 37, 39</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IOUS</td>
<td>92% (84–96)</td>
<td>109/3</td>
<td>28, 40, 41</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duodenal tumors and lymph node metastases</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>US</td>
<td>18%</td>
<td>25/1</td>
<td>33</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EUS</td>
<td>63%</td>
<td>59/2</td>
<td>33, 36</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liver metastases</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>US</td>
<td>88%</td>
<td>95%</td>
<td>131/1</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>CEUS</td>
<td>82%</td>
<td>48/1</td>
<td>42</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Data in the literature on the sensitivity, specificity and detection rate for NET diagnosis by US, EUS, IOUS and CEUS.
The application of MRI for locoregional staging of rectal NETs is mentioned earlier in the CT section of this paper. Imaging of distant metastases in bone (fig. 9) and brain (fig. 10) is advantageous by MRI.

**Documentation and Reporting of Results**

The documentation and reporting of results of MRI is similar to that of CT. The standardised report used for rectal cancer, according to the consensus conferences, must be used.

**Ultrasound**

**Sensitivity, Specificity and Detection Rates**

US is known to be an operator-sensitive modality leading to wide variation regarding sensitivity and specificity of the reported series. The US-, EUS-, IOUS- and CEUS-acquired sensitivity, specificity and detection rate (mean and range based on the number of patients and studies) for NETs at various anatomical sites is presented in table 3.

For EPT diagnosis, a mean 39% (range 17–79%) detection rate was found in 6 studies including 153 patients [28–33]. EUS is the most sensitive method for diagnosing EPTs and a mean 90% (range 77–100%) detection rate was shown in 10 studies comprising 261 patients [10, 29–31, 33–38]. In a study on 75 patients the sensitivity was 93% and the specificity 95% [39]. IOUS is also a sensitive method for detecting EPTs with a mean 92% (range 74–96%) detection rate reported in 4 studies that included 127 patients [28, 31, 40, 41]. When insulinomas are considered separately, the mean detection rate of EUS was 92% (range 88–94%) in 4 studies including 86 patients [10, 30, 37, 39] and that of IOUS, 92% (range 84–96%) in 3 studies on 109 patients [28, 40, 41].

For duodenal tumors and lymph node metastases, the detection rate of US was 18% in a study on 25 patients [33] and that of EUS 63% in 2 studies comprising 59 patients [33, 36].

Studies reporting on US for the detection of liver metastases exclusively from NETs are scarce. However, in one study including 131 patients with various NETs, US exhibited an 88% sensitivity and 95% specificity, whereas in a subgroup of 87 patients with carcinoid tumors the corresponding figures were 82 and 92%, respectively [12]. CEUS has been shown to be more sensitive for the diagnosis and characterisation of liver lesions than conventional US. In 48 patients with NETs and suspicion of liver metastases, the sensitivity of CEUS was 82% [42]. The diagnostic yield of US-guided biopsies in 129 patients was shown to improve by CEUS compared to conventional US [43]. Liver haemangiomas were easier to characterise by CEUS than by pre-contrast US [44].

**Hard- and Software Requirements**

The possibility of using different transducers with appropriate ultrasound frequencies is important. The deeper portions of the abdomen require better penetration of a low-frequency transducer than more superficial areas where a high frequency transducer is preferred. With the recent development of US transducer, the frequency in one single transducer may be adjusted according to the different needs during the examination. By harmonic imaging technique the sensitivity of US can be improved. The use of i.v. CM for US is an important development of the technique, and preferably the US equipment software should allow for CEUS.

**Patient Information and Preparation**

The patient needs to be informed that the examination generally lasts 15–30 min, unless CEUS, which lasts longer, is performed. During US of the abdomen patients may repeatedly need to hold their breath for a few seconds, and the insertion of an i.v. catheter before CEUS may cause some discomfort.

**Information Provided by the Clinician**

US of the abdomen in obese patients is difficult to perform and tends to be unreliable as abdominal organs cannot be sufficiently penetrated. These patients are better candidates for CT or MRI examination. An exception from this rule is US-guided biopsy, which can always be tried and, if needed, converted into a CT-guided procedure. The referring physician needs to provide information regarding the patient's diagnosis, kind of medical therapy, previous surgery, kind of surgery and the findings at surgery and results of previous imaging examinations. If CEUS is contemplated, information should be provided regarding previous insertion of cardiac valve prosthesis since the use of i.v. CM for US in these patients presently is not accurate (bubbles are broken by such prosthesis), and recent cardiac angina is a contraindication due to the risk of acute cardiac insufficiency. Please see also pertinent parts in the corresponding paragraph regarding CT and MRI.

**Examination Technique**

As opposed to CT, which allows detailed examination of the whole abdomen and of additional body regions...
(thorax, neck) at the same session, US is better suited for examination of limited parts of the abdomen, for example the pancreas and the liver.

Because US is an operator-dependent procedure, an optimal examination technique is essential. Examination by using different transducer frequencies is important. Low frequencies (about 3 MHz) better penetrates tissues, but high frequencies (approx. 5 MHz) allow for higher spatial resolution. The advantage and drawback of the high and low frequencies must be considered during the examination and used accordingly for examination of deep and superficial parts of the abdominal organs, respectively. Abdominal organs are generally easier to examine during a breath hold, and it is often advantageous to place the patient in different positions on the examination couch and perform US while the patient is standing up or during a Valsalva manoeuvre enlarging the abdominal wall. This can be especially helpful for the examination of the pancreas, when bowel gas, especially in the transverse colon, prevents accurate ultrasound penetration.

Doppler techniques (power Doppler, colour-coded Doppler) are valuable in order to evaluate the tumor vascularity and are helpful in distinguishing vascular from non-vascular tubular structures.

By dynamic CEUS the temporal and spatial pattern of tumor uptake and washout (in- and outflow) of the CM may be evaluated. CEUS may therefore be considered for localisation of EPTs and NET liver metastases. By CEUS, liver metastases in the 2- to 3-mm range may be readily detected and previously equivocal tumor findings at unenhanced US, or CT, may be characterised. CEUS is mandatory when percutaneous radiofrequency ablation of liver metastases is considered. A limitation of the technique, however, is that the whole liver may not be evaluated by US during all phases of contrast enhancement.

In case of negative preoperative US in patients with the Zollinger-Ellison syndrome, peroperative US is recommended by which the duodenal wall and pancreatic head can be explored.

**Image Findings**

Abdominal ultrasound and CT are complementary radiological methods used to diagnose EPTs, liver metastases, lymph node and mesenteric metastases and these are an excellent tool for guiding the biopsy needle to obtain a tumor tissue specimen (fig. 11). By US, the bile ducts, the pancreatic duct and vessels may be evaluated for dilatation and tumor invasion and free fluid in the abdomen and pleural spaces may be detected.

Intestinal tumors are rarely detected but are occasionally seen as a low echogenic wall thickening or polypoid tumor, which is well vascularised. A large locally advanced intestinal NET infiltrating the surrounding tissues is more easily detected. The ability of US to differentiate an adenocarcinoma of the colon from a NET is poor.

An EPT is typically a low echogenic and hypervascular lesion. As with CT and MRI, the local extent of the tumor should be assessed. The relation of the EPT to the pancreatic duct and the common bile duct should be determined as well as any encasement or invasion of the splenic vein and the superior mesenteric artery and vein.

Mesenteric metastases from a midgut carcinoid and mesenteric and retroperitoneal lymph node metastases are seen as low echogenic masses. The desmoplastic reaction, which by CT and MRI is a characteristic feature of a mesenteric metastasis from a midgut carcinoid, cannot be detected by US.

NET liver metastases cannot be differentiated from any other type of liver metastases. Small (<1 cm) metastases generally appear as low echogenic rounded lesions, whereas large (>1 cm) metastases usually are highly echogenic (fig. 11) with a low echogenic halo and may have central low echogenic necrosis. These lesions often appear hypervascular by Doppler techniques and CEUS. In patients with fatty infiltration of the liver, resulting in a
high echogenic normal parenchyma, the NET metastases may instead appear low echogenic.

**Documentation and Reporting of Results**

The documentation and reporting of results by US is similar to that of CT and MRI. However, for therapy monitoring, the reported lesion sizes by US are generally difficult to compare with those measured by CT and MRI. This is because the size of the lesions, according to the WHO and RECIST criteria, are measured in the transaxial CT and MRI images whereas by US these tumors are measured in undefined anatomical imaging planes. Usually the US measurement is performed in the plane in which the lesions by US appear largest. Also, an overview of the tumor load is generally difficult to make by US in patients with extended disease. For example, the assessment of the tumor burden by US in a patient in whom the normal liver is almost replaced by metastases is generally unreliable. Therefore, US is not employed for initial diagnosis or therapy monitoring in clinical trials (except to evaluate superficial tumor lesions as an adjunct to estimating the lesion size by palpation). However, in the clinical setting, US is an excellent method for diagnosis and characterisation of NETs. Since CT and US are complementary imaging methods, they may both be advantageous for using therapy monitoring in order to decrease the radiation dose to the patient, particularly to those who are young and have a long life expectancy.

**List of Participants**

List of Participants of the Consensus Conference on the ENETS Guidelines for the Standard of Care for the Diagnosis and Treatment of Neuroendocrine Tumors, Held in Palma de Mallorca (Spain), November 28 to December 1, 2007

Göran Åkerström, Department of Surgery, University Hospital, Uppsala (Sweden); Bruno Annibale, University Sapienza Roma, Rome (Italy); Rudolf Arnold, Department of Internal Medicine, Philipps University, Munich (Germany); Emilio Bajetta, Medical Oncology Unit B, Istituto Nazionale Tumori, Milan (Italy); Jaroslava Barkmanova, Department of Oncology, University Hospital, Prague (Czech Republic); Yuan-Jia Chen, Department of Gastroenterology, Peking Union Medical College Hospital, Chinese Academy of Medical Sciences, Beijing (China); Frederico Costa, Hospital Sirio Libanes, Centro de Oncologia, Sao Paulo (Brazil); Anne Couvelard, Service de Gastroentérologie, Hôpital Beaujon, Clichy (France); Joseph Davar, Department of Cardiology, Royal Free Hospital, London (UK); Wouter de Herder, Department of Internal Medicine, Section of Endocrinology, Erasmus MC, Rotterdam (The Netherlands); Gianfranco Delle Fave, Ospedale S. Andrea, Rome (Italy); Barbro Eriksson, Medical Department, Endocrine Unit, University Hospital, Uppsala (Sweden); Massimo Falconi, Medicine and Surgery, University of Verona, Verona (Italy); Diego Ferone, Departments of Internal Medicine and Endocrinological and Metabolic Sciences, University of Genoa, Genoa (Italy); David Gross, Department of Endocrinology and Metabolism, Hadassah University Hospital, Jerusalem (Israel); Ashley Grossman, St. Bartholomew's Hospital, London (UK); Björn Gustafsson, Medisinsk avd, Gastroeskejon, St Olavs Hospital, Trondheim (Norway); Rudolf Hyrdel, II. Internal Medical Department, University Hospital Martin, Martin (Slovakia); Diana Ivan, Endocrinology and Diabetology, Klinikum der Philips-Universität, Marburg (Germany); Reza Kianmanesh, UFR Bichat-Beaujon-Louis Mourier, Service de Chirurgie Digestive, Hôpital Louis Mourier, Colombes (France); Günther Klöppel, Institut für Pathologie, TU München, Munich (Germany); Ulrich-Peter Knigge, Department of Surgery, Rigshospitalet, Copenhagen (Denmark); Paul Komminoth, Institute for Pathology, Stadtspital Triemli, Zürich (Switzerland); Beata Kas-Kudla, Saska Akademia Medyczna Klinika Endokrynologii, Zabrze (Poland); Dik Kwekkهو, Department of Nuclear Medicine, Erasmus University Medical Center, Rotterdam (The Netherlands); Rachida Lebtahi, Nuclear Medicine Department, Bichat Hospital, Paris (France); Val Lewington, Royal Marsden, RHS Foundation Trust, Sutton (UK); Anne Marie McNicol, Division of Cancer Sciences and Molecular Pathology, Pathology Department, Royal Infirmary, Glasgow (UK); Emmanuel Mitry, Hepatogastroenterology and Digestive Oncology, Hôpital Ambroise-Paré, Boulogne (France); Ola Nilsson, Department of Pathology, Sahlgrenska sjukhuset, Gothenburg (Sweden); Kjell Oberg, Department of Internal Medicine, Endocrine Unit, University Hospital, Uppsala (Sweden); Juan O'Connor, Instituto Alexander Fleming, Buenos Aires (Argentina); Dermot O'Toole, Department of Gastroenterology and Clinical Medicine, St. James's Hospital and Trinity College Dublin, Dublin (Ireland); Ulrich-Frank Pape, Department of Internal Medicine, Division of Hepatology and Gastroenterology, Campus Virchow-Klinikum, Charité-Universitätsmedizin Berlin, Berlin (Germany); Mauro Papotti, Department of Biological and Clinical Sciences, University of Turin/St. Luigi Hospital, Turin (Italy); Marianne Pave, Department of Pathology and Gastroenterology, Campus Virchow-Klinikum, Charité-Universitätsmedizin Berlin, Berlin (Germany); Ariel Perren, Institut für Allgemeine Pathologie und Pathologische Anatomie der Technischen Universität München, Klinikum r.d. Isar, Munich (Germany); Marco Platania, Istituto Nazionale dei Tumori di Milano, Milan (Italy); Guido Rindi, Department of Pathology and Laboratory Medicine, Universität degli Studi, Parma (Italy); Philippe Ruszniewski, Service de Gastroentérologie, Hôpital Beaujon, Clichy (France); Ramon Salazar, Institut Catalá d’Oncologia, Barcelona (Spain); Aldo Scarpa, Department of Pathology, University of Verona, Verona (Italy); Klemens Schaidhauer, Klinikum rechts der Isar, TU München, Munich (Germany); Jean-Yves Scoazec, Anatomie Pathologique, Hôpital Edouard-Herriot, Lyon (France); Waldemar Szpak, Westville Hospital, Mayville (South Africa); Babs Taal, Netherlands Cancer Centre, Amsterdam (The Netherlands); Pavel Vitek, Institute of Radiation Oncology, University Hospital, Prague (Czech Republic); Bertram Wiedemann, Department of Internal Medicine, Division of Hepatology and Gastroenterology, Campus Virchow-Klinikum, Charité-Universitätsmedizin Berlin, Berlin (Germany).

Radiological Examinations in Patients with Neuroendocrine Tumors
References