Management of Incidental Findings in Patients

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There are major differences how to deal with incidental findings in study participants and patients. While a study participant might see himself as part of a research project, he is less likely to expect diagnoses from cross-sectional imaging examinations. In contrast, a patient in a clinical setting undergoes imaging examinations for a particular reason, that is, to exclude, confirm, or follow up a certain diagnosis. Therefore, the patient expects a particular – positive or negative – report related to the original clinical question. Additional findings not related to the initial indication for the examination are generally reported. These incidental findings need to be handled carefully both by the reporting radiologist and by the physician in charge. Well-considered recommendations given by the radiologist are the most important part of handling incidental findings responsibly. Depending on certain parameters, such as the chosen modality or the image quality, differentiating between "normal" and "pathological" becomes a real challenge for several incidental findings. The reporting radiologist has to decide how to report and assess those incidental findings. By now, there are several recommendations by different societies and committees that can help radiologists in the assessment of incidental findings. In this chapter, we aim to give a brief overview of the most helpful recommendations, which refer to the most frequently occurring incidental findings on thoracic and abdominal CT or MRI.

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1 Pulmonary Incidental Findings

For the assessment of pulmonary nodules, the guidelines of the Fleischner Society are well established. Their recommendations for solid and subsolid lung nodules can help the radiologist in classifying a finding as (most likely) benign and advising follow-up examinations.

1.1 Small Pulmonary Nodules

Small pulmonary nodules are very common findings. They can be detected in scans that involve the whole chest, for example, a trauma scan after a car crash, as well as in scans that only show parts of the lung parenchyma such as a contrast-enhanced CT scan of the supra-aortic arteries. The likelihood increases with the age of the patient collective, and is higher in smokers than in nonsmokers. With current modern scanners, detecting even the smallest nodules with 1–2 mm in diameter has become routine. Since only a slight percentage of incidentally detected, small pulmonary nodules will be malignant, controlling all of them several times is not feasible. Therefore, the Fleischner Society published a position paper in 2005 (MacMahon et al. 2005). This paper should provide practical guidelines for the management of incidentally detected, small pulmonary nodules. The given recommendations apply to adult patients (>35 years) without any known or suspected malignant disease and without fever. The guidelines are based on several follow-up studies evaluating the risk of having or developing lung cancer when a small pulmonary nodule is found. For this assessment, several characteristics of incidental, small pulmonary nodules need to be taken into consideration, such as nodule size, growth rate, and risk factors: the larger the nodule the more likely it is malignant, and follow-ups need to be more frequent. Growth rates of lung nodules differ between ground-glass opacities, ground-glass opacities with a solid component, and solid nodules, with solid nodules showing the shortest mean volume-doubling time. Furthermore, the relative risk for developing lung carcinoma is an important parameter, with smoking being the most important risk factor. For example, the Fleischner Society follow-up and management recommendations for incidentally detected, small pulmonary nodules say that no follow-up is needed for a nodule smaller than 4 mm in a patient with a minimal or absent history of smoking and of other known risk factors. If a nodule of the same size is found in a patient with a history of smoking or with other known risk factors, a follow-up CT after 12 months is recommended. If the nodule size is unchanged, no further scans are required. But, it needs to be considered that a ground-glass or partly solid nodule may require a longer follow-up to exclude indolent adenocarcinoma due to a longer mean volume-doubling time of nonsolid nodules (MacMahon et al. 2005). Equivalent recommendations are given for nodules with a size between 4 and 6 mm, 6 and 8 mm, and for those larger than 8 mm (for further details, please see the table "Recommendations for follow-up and management of nodules smaller than 8 mm detected incidentally at non-screening CT" (MacMahon et al. 2005)).

1.2 Subsolid Pulmonary Nodules

The recommendations mentioned above already cover a significant proportion of the different types of incidentally detected lung nodules. However, these guidelines lack a detailed consideration of subsolid lung nodules. Therefore, the Fleischner Society provided additional recommendations for the management of subsolid pulmonary nodules in 2012 (Naidich et al. 2013). The term "subsolid" in this paper encompasses the entity of "pure ground-glass nodules" (pure GGN) where no solid component is present and the "part-solid ground-glass nodules" (part-solid GGN) that include a solid component. An important difference between the guidelines from 2005 and the additional recommendations from 2012 is that there is no low-risk/high-risk distinction between smokers and nonsmokers. The main characteristics are the overall size of the lesion(s) and the size of the solid component, if present.

For image acquisition and quality, contiguous thin sections (1 mm) reconstructed with narrow and/or mediastinal windows are recommended to evaluate the solid component. Additionally, wide and/or lung windows will be needed to evaluate the nonsolid component of nodules. The authors further advise the use of a consistent low-dose technique.This is of particular importance in cases for which prolonged follow-up scans are recommended as well as in younger patients. If several scans are available over time, it is important to always compare with the original baseline study to detect subtle changes in growth (Naidich et al. 2013). For example, a solitary, pure GGN ≤5 mm would not require a follow-up CT scan according to the "Recommendations for the management of subsolid pulmonary nodules detected at CT.". Whereas a solitary, pure GGN >5 mm requires a follow-up at 3 months. If the GGN is unchanged in this scan, an annual surveillance for a minimum of 3 years is recommended. If multiple, pure GGN ≤5 mm are found, a follow-up at 2 and 4 years is recommended, and alternate causes for those multiple nodules should be considered. (For supplementary details, please see the table "Recommendations for the management of subsolid pulmonary nodules detected at CT" (Naidich et al. 2013)).

1.3 Pulmonary Perifissural Nodules

Pulmonary perifissural nodules (PFN) represent another important entity of pulmonary nodules commonly seen on chest scans. It is likely that the majority of these nodules represent lymph nodes. This can be hypothesized by their demonstrated growth rate (they can expand or regress over time), morphological features, and resected PFN. Adequate assessment of pulmonary nodules as PFN plays an important role in reducing the number of recommended follow-up scans. Within the framework of the Dutch–Belgian Randomised Lung Cancer Screening Trial (NELSON), de Hoop et al. have been evaluating PFN over time. Perifissural nodules have been categorized as typical PFN, atypical PFN, and non-PFN. A typical PFN was defined as fissure-attached, homogeneous, solid nodule with smooth margins and a triangular, lentiform, or oval shape. An atypical PFN was not fissure-attached, but perifissural, otherwise showing all features of a typical PFN. All other nodules not meeting these criteria were defined as non-PFN, including spherical or speculated nodules. In the study of de Hoop et al., none of the typical or atypical-defined PFN showed signs of malignancy in the 5.5 years of follow-up (de Hoop et al. 2012).

2 Abdominal Incidental Findings

In 2010 and 2013, ACR Incidental Findings Committee published detailed recommendations on managing incidental findings on abdominal CT and MRI. Different subcommittees compiled flowcharts and tables based on numerous reviews and original papers. The White Papers of the ACR Incidental Findings Committees I and II give a comprehensive overview over most of the abdominal incidental findings and provide helpful tools for every radiologist. Only a selection of recommendations for the most common abdominal incidental findings will be presented here.

2.1 Cystic Renal Mass

Cystic renal masses are among the most frequent incidental findings. As such, they can be partially imaged, for example, on a chest scan, or fully imaged on an abdominal MRI or CT scan or an abdominal ultrasound. The great majority of cystic renal masses can be characterized sufficiently using ultrasound or a contrast-enhanced CT. The first step in managing incidental cystic renal masses is to exclude nonneoplastic causes such as infections, for example, pyelonephritis.

It is well established to categorize cystic renal masses according to the approach of Bosniak. In this classification, the size of the lesion is subordinate to the characterization of the wall and septa if present. The management of incidental

cystic renal masses should be adapted if comorbidities are present or life expectancy is limited. In these patients, observing a lesion might be a better approach than surgery. Therefore, the recommendations for managing incidental cystic renal masses differentiate between "general population" and patients with severe comorbidities or a limited life expectancy. Still, the recommendations given by the ACR Incidental Findings Committee need to be adapted individually. Depending on the patient, the image quality and the experience of the reporting radiologist, duration and frequency of controls may be changed, or a certain approach might be favoured (Berland et al. 2010; Silverman et al. 2008). (For further details, please see the table "Management recommendations for patients with incidental cystic renal masses" (Silverman et al. 2008).)

The Incidental Findings Committee elaborated a detailed flowchart with recommendations for managing incidental cystic renal masses detected on CT. Within this flowchart, green "action boxes" indicate where action is needed either in the form of follow-up imaging or in form of a surgical approach; this would be necessary in Bosniak IIF and Bosniak III or IV lesions. If a Bosniak IIF lesion reveals morphological changes in the follow-up, surgery should be considered. Morphological change is especially referring to a change in characteristic features, such as number and thickness of septations. Growth of a Bosniak IIF lesion should be reported, but is by itself not indicating malignancy. Red boxes indicate that no further follow-up is necessary as for Bosniak I and II cysts. (For further details, please see "Flowchart for incidental cystic renal mass detected on CT" (Berland et al. 2010)).

2.2 Liver Mass

Due to technical advantages, there are liver masses that can be detected on CT, MRI, and PET that in the past remained undiscovered. Especially in oncological patients, it is of vital importance to distinguish a benign incidental liver lesion from a malignant lesion. The recommendations about managing incidental liver masses detected on CT by the Incidental Findings Committee had been assessed by the appearance of the liver lesion and by the patients' risk factors to develop an important liver mass. The appearance of the lesion includes the size (<0.5 cm, 0.5–1.5 cm, and >1.5 cm), margins, attenuation, and enhancement. A low-risk patient is defined as a young patient (≤40 years) with no known malignancies, hepatic dysfunction, risk factors for hepatic malignancies, or symptoms typical for liver diseases. An average risk is attributed to a patient >40 years with no known malignancies, hepatic dysfunction, risk factors for hepatic malignancies, or symptoms typical for liver diseases. A high-risk patient has a known primary malignancy with propensity to metastasize to the liver, liver cirrhosis, or other hepatic risk factors including hepatitis, sclerosing cholangitis, hemochromatosis, hepatic dysfunction, and long-term oral contraceptive medication (Berland et al. 2010). For example, an incidental liver mass smaller than 0.5 cm in a patient with a low or average risk profile is considered benign and needs no further follow-up. An incidental liver mass of the same size in a patient with known cirrhosis or hemochromatosis, for example, requires follow-up in CT or MRI in 6 months. If this patient is a candidate for liver transplant, then follow-ups need to be more frequent. An incidental liver mass >1.5 cm with low attenuation, ill-defined margins, and an enhancement > 20 HU should be followed up in a low-risk patient and further evaluated in a patient with an average risk profile using multiphasic MRI. If such a lesion is found in a high-risk patient, biopsy is recommended. (For supplemental details, please see "Flowchart for incidental liver mass detected on CT" (Berland et al. 2010)).

2.3 Adrenal Mass

An adrenal incidentaloma is an adrenal mass ≥1 cm incidentally discovered on cross-sectional imaging. Such adrenal incidentalomas are quite common, and most frequently pathology reveals a nonhyperfunctioning adenoma. Less common benign lesions are myelolipomas, cysts, or

hemorrhage. Due to the high prevalence of non-hyperfunctioning adrenal adenomas, an incidentally discovered adrenal mass is most likely to be benign, both in patients with no known malignancy and in oncology patients (Berland et al.2010). However, there are cancer entities that metastasize to the adrenal gland, including lung and breast cancer, malignant melanoma, and renal cancer (McLean et al. 2011). Furthermore, there are primary adrenal tumors such as pheochromocytomas or primary adrenocortical carcinomas. As with every incidental finding, the aim is to differentiate between benign lesions where no further evaluation is needed and potentially malignant lesions that require treatment. The detailed algorithm from the Incidental Findings Committee distinguishes between diagnostic and nondiagnostic imaging features. If an adrenal mass shows density values ≤10 Hounsfield Units on unenhanced CT, this is considered diagnostic of an adrenal adenoma; therefore, no follow-up is recommended. If the imaging features are not diagnostic, the reporting radiologist has to compare the lesion to prior imaging, if available. Size, imaging features, growth over time, and the patient's history need to be considered. To distinguish between adenomas and metastases, a closer look at the contrast enhancement and washout following contrast administration might help. Both adenomas and metastases enhance rapidly. While adenomas show a rapid washout as well, metastases show a prolonged washout. If an unenhanced CT scan is available, the absolute percentage washout (APW) can be calculated using the formula (enhanced HU – 15-min delayed HU)/(enhanced HU – unenhanced HU) × 100. An APW value ≥60 % is diagnostic of an adenoma. If no unenhanced CT scan is available, the relative percentage washout (RPW) can be calculated, and the formula needed is (enhanced HU – 15-min delayed HU)/enhanced HU × 100. Using this formula, a RPW value >40 % is diagnostic of an adenoma (Berland et al. 2010). Following the "Flowchart for incidental adrenal mass detected on CT or MR" might help the reporting radiologist to give a well-considered recommendation. The management recommendation might have to be adapted according to patient wishes, imaging quality, or the experience level of the reporting radiologist (Berland et al.2010).

2.4 Adnexal Findings

The following recommendations given by the ACR Incidental Findings Committee II on Adnexal Findings address incidental findings detected on cross-sectional imaging (CT or MRI) in nonpregnant, postmenarchal patients with no known or suspected adnexal disorder. In contrast to a gynecological ultrasound, it is not common to document the date of the patient's last menstrual period prior to a CT or MRI scan. Though, knowing the date of the last menstrual period might help the reporting radiologist to interpret adnexal findings in premenopausal patients. If the onset of menopause in patients around or older than 50 years is unknown, 50 years can be used as an arbitrary designation for the age of menopause. Postmenopause can be divided into early postmenopause within 5 years after the final menstrual period and the late postmenopause >5 years from the last menstruation. This division might help to evaluate incidental adnexal findings in postmenopausal women.

When follicles are counted as cysts, incidental adnexal cysts are almost ubiquitous in premenopausal women and quite common in postmenopausal women. Adnexal cysts are categorized by their morphology into benign-appearing and probably benign cysts. A benign-appearing cyst is an oval or round unilocular mass of uniform fluid signal and attenuation. It has a regular shaped or imperceptible wall and shows no solid areas or mural nodules. The maximum diameter is <10 cm. If the patient is premenopausal, the cyst can contain layering hemorrhage. A probably benign cyst shows angulated margins, and the shape is neither round nor oval. Furthermore, a cyst is defined as probably benign if a portion of the cyst is poorly imaged (e.g., due to metal streak artifacts) or the image has a reduced signal-to-noise ratio (due to technical parameters or to an unenhanced scan). Additionally, it is use-

ful to differentiate whether the cysts are detected in premenopausal or postmenopausal women (Patel et al.2013).

2.4.1 Adnexal Cysts in Premenopausal Women

Because nonneoplastic, physiological cysts in premenopausal women are very common, a benign-appearing or probably benign cyst with a maximum diameter ≤3 cm should be considered normal. Evaluating the morphology of a cyst with a maximum diameter >3 cm in CT or MRI should permit a statement which category the cyst belongs to: benign-appearing or probably benign. An incidental, benign-appearing, asymptomatic cyst with a maximum diameter ≤5 cm will not need further evaluation. Short-interval follow-up with ultrasound is recommended for benign-appearing cysts >5 cm and probably benign cysts >3 cm, because small mural nodules might not be detectable in primary CT or MRI. The recommended interval is 6–12 weeks; during this time, the cyst may decrease in size or resolve. If the cyst persists, the ultrasound will help to evaluate possible small mural nodules, which are seen in some borderline malignancies.

2.4.2 Adnexal Cysts in Postmenopausal Women

Simple cysts are quite common in women in early and late postmenopause. The majority of these cysts are <3 cm, and a malignant cyst is very rare. The pathogenesis of those nonmalignant cysts includes paraovarian or paratubal cysts as well as cystadenomas and cystadenofibromas. It is recommended that incidental, adnexal cysts with a maximum diameter ≤1 cm in early or late postmenopausal women should be considered benign unless there are suspicious imaging features of metastatic ovarian cancer. In early postmenopause follow-up, ultrasound in 6–12 months is recommended for benign-appearing cysts >3 and ≤5 cm; a direct ultrasound evaluation is recommended for cysts >5 cm. A benign-appearing cyst >3 cm in late postmenopause should be evaluated promptly with ultrasound. Direct evaluation with ultrasound is further recommended for probably benign cysts >3 cm in early postmenopause and >1 cm in late postmenopause.

For additional details, please see "Incidental adnexal cystic mass flowchart" (Patel et al. 2013).

3 Summary

Managing incidental findings in patients is a daily task for every practicing radiologist. Thus, it is crucial to give well-considered recommendations on whether and how to follow up incidental findings. Patient's comorbidities, imaging quality, experience in reporting, as well as psychological stress for the patient and resulting costs for the health care system, are factors that need to be taken into consideration. The Fleischner Society and the ACR Incidental Findings Committee I and II published helpful recommendations over the last few years regarding thoracic and abdominal incidental findings. These recommendations provide useful guidance, but may need to be adapted to every individual case.

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