CT and CT-Colonography

62

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62.1 Computed Tomography

Preoperative CT is indicated in suspicion of hematogenous or distal nodal metastatic disease or invasion into adjacent organs or formation of abscess and presence of atypical symptoms.

Abdominal CT must be performed with an intravenous contrast agent. The portal phase must be used either as a single phase or combined with arterial and late phases.

At CT colorectal cancer appears as a soft tissue mass or wall thickening with luminal narrowing. Colonic obstruction, perforation, and fistula are complications that can be visualized with CT. Local spread is seen by loss of fat planes between colon and adjacent organs, extracolic mass, thickening and infiltration of pericolic fat, and involvement of adjacent organs (Fig. 62.1). The sensitivity, specificity, positive predictive value, and negative predictive value of CT in indentifying tumor extension in pericolic fat ranges from 74 to 79 %, 33–67 %, 91, and 15 %, respectively. In one series the sensitivity and specificity of CT in indentifying T3 and T4 tumors were 87 and 49 %, respectively. Sensitivity and specificity for tumor infiltration beyond the muscularis propria were 95 and 50 %, respectively [1].

The specificity of CT for N staging based on size criteria is high (96 %) but the sensitivity is low. The accuracy ranges from 62 to 75 % [2]. Small or normal-sized nodes may have micrometastatic disease whereas large nodes (larger than 1–1.5 cm in short axis diameter) may be reactive. Radiological T and N categories using CT staging are independent prognostic factors for both overall survival and free survival in patients who underwent curative resection.

Hepatic metastases are seen as hypoattenuating lesions in portal phase of contrast-enhanced CT with a sensitivity of more than 90 % for lesions larger than 1 cm of diameter. The accuracy, specificity, and sensitivity are 85, 97, and 74.4 %, respectively. Cystic or calcified hepatic metastases can be seen in mucinous cancer. Lungs, adrenal glands, bones, and peritoneum are other common sites of metastatic disease.

CT can be used to find lung metastases preoperatively but not as a routine procedure.

CT is useful for the treatment planning especially for postoperative comparison. The accuracy of preoperative CT in staging ranges from 48 to 77 %. Poor prognostic features like T-stage, N-stage, extramural extension, and involvement of retroperitoneal surgical margin can be predicted using CT with accuracy of 82–94.1 %. In this way, patients with a poor prognosis can be indentified and may be suitable for neoadjuvant chemotherapy [1].

Recurrent tumor after surgery looks like as a soft-tissue mass in the surgical site which enlarges over time, enlarged regional lymph

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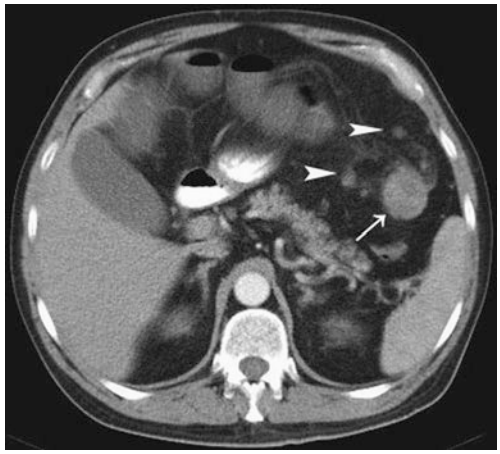

Fig. 62.1 Enhanced CT of the abdomen shows a mass in the left colic flexure (*arrow*), infiltration of the pericolic fat, and small lymph nodes (*arrowheads*)

nodes, and invasion of adjacent structures. CT is helpful to diagnose recurrent metastases in liver or extra abdominal sites.

62.2 CT Colonography

62.2.1 Introduction

The first description of Computed tomographic colonography (CT colonography) or virtual colonoscopy was reported in 1994. It is a minimally invasive examination for the colon and rectum.

62.2.2 Indications-Contraindications

CT colonography is useful in patients with incomplete colonoscopy due to colonic tortuosity or stenosis, diverticulosis, obstructive cancer, or in those with contraindication for optical colonoscopy (anticoagulant drugs or diseases with increased risk from anesthesia). CT colonography can also be used for colon cancer screening. The examination is contraindicated in colon perforation, toxic megacolon, recent rectal operation, proctitis and polyp excision, or biopsy into the last 6 days period.

62.2.3 Technique

The day before the study, a clear liquid diet along with cathartics for adequate bowel preparation is required, because polyps cannot be differentiated from retained stools. Barium and/or iodine oral contrast agents can be used for tagging of residual fluid and solid stool.

CT colonography with cathartic—free faecal tagging yields high positive predictive values (92.8 %) and is well accepted by the patients [3].

The colon is distended with carbon dioxide or room air through a small-caliber rectal catheter by automated or manual insufflation. No sedation is needed.

The abdomen is scanned with the patient in prone and supine positions in less than 2 min. Approximately 10 min is the duration of the CT table procedure. Intravenous contrast is helpful for differentiation of colonic fluid from polyps and for patients with more advanced symptoms. 2-D images in axial coronal and sagittal planes and 3-D image display techniques for interpretation are used. Evaluation of extracolonic structures is feasible with 2-D images (Fig. 62.2).

62.2.4 Efficacy and Test Performance Characteristics

Measurements of polyp size at CT colonography are 1–2 mm smaller than colonoscopic and 1–2 mm larger than pathologic measurements.

The reference standard for the CT colonography performance characteristics for detection of polyps is optical colonoscopy. In one series, the sensitivity and specificity for large polyps is 90 and 86 %, respectively [4] whereas in another one, sensitivity of 85 % and specificity of 87 % for large polyps was achieved [5]. Detection rates for advanced neoplasia are similar in CT colonography and colonoscopy.

CT colonography compared with colonoscopy has a negative predictive value (NPV) of 96.3 % overall. The positive predictive value (PPV) is 90 %. When limited to fecal occult blood tests, the positive persons NPV is 84.9 %.

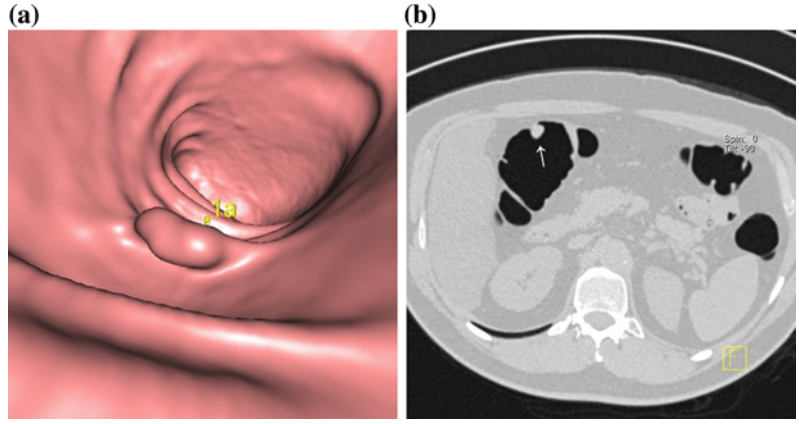

Fig. 62.2 Colonic adenoma with pathological confirmation in a patient who underwent CT colonography as a screening test. **a** 3-D image shows a polypoid lesion (1a). **b** 2-D axial CT image shows a soft tissue polypoid lesion (*arrow*) located at the right colic flexure

The per-patient and per-lesion PPVs of CT colonography after incomplete colonoscopy for masses (≥20 mm), large polyps (10–19 mm), and medium polyps (6–9 mm) are 90.9 and 91.7 %, 64.7 and 70 %, and 33.3 and 30.4 %, respectively [6].

In a post–hoc analysis of data from the US National CT Colonography trial no statistically significant differences have been found in the diagnostic performance of CT colonography between patients older than 65-years of age and younger participants for the detection of intermediate-size and large adenomas. Some meta-analyses have been published to summarize the available data. In one, 47 studies providing data of 10,546 patients were included. Overall per-polyp and per patient sensitivity of CT colonography was 66 and 69 %, respectively. Overall CT colonography specificity was 83 % [7].

A recent meta-analysis included 49 studies (compromising a total of 11,151 patients) and calculated sensitivity of CT colonography 96.1 % [8]. Another one included five studies (compromising 4,086 asymptomatic patients) and estimated sensitivity for patients with polyps or adenomas ≥6 mm 75.9 % and corresponding specificity 94.6 %, whereas for patients with polyps or adenomas ≥10 mm sensitivity 83.3 % and specificity 98.7 % [9].

62.2.5 Safety

Complications from CT colonography are rare. The incidence of symptomatic colonic perforation is small but definite. Rates at between 0.06 and 0.08 % have been reported, which approaches the complication rates reported for colonoscopy. This comparison may be biased because CT colonography is performed in many patients after colonoscopy failed. Risk factors are age, diverticular disease, colonic obstruction, and recent colonoscopy, especially with recent biopsy.

Low—pressure delivery of carbon dioxide for colonic distention may be safer than insufflation of room air. Pneumatosis of the right colon, a rare asymptomatic condition which is self-limited is associated with delivery of carbon dioxide at CT colonography.

Another issue is the radiation exposure. The effective dose for CT colonography is approximately 7–10 mSv for dual positioning, both supine and prone. Median effective dose for CT colonography is significantly lower for screening than for daily practice protocols (4.4 and 7.6 mSv respectively). Although low radiation dose protocols are used, these do not appear to reduce overall radiation exposure. The benefits from CT colonography screening every 5 years from the age of 50–80 years outweigh the radiation risks [10].

62.2.6 Patient Acceptance

For CT colonography sedation or recovery time is not required. Patients prefer CT colonography over colonoscopy because the test is noninvasive, they avoid sedation/anesthesia, they are able to drive after the test, they avoid colonoscopy risks and the test is able to identify abnormalities outside the colon. The preference rates for CT colonography and colonoscopy in patients who had experienced both procedures are 77 and 13.8 %, respectively [11].

The worst part of the procedure is bowel preparation. Limited bowel preparation for CT colonography with faecal tagging only without laxatives does not prevent high diagnostic accuracy.

62.2.7 Follow-Up

Diminutives polyps (≤5 mm in size) detected at CT colonography screening, must be ignored according to American College of Radiology because the risk cancer is extremely low. Referral of patients with diminutive polyps for colonoscopy would dramatically increase the cost of screening.

CT colonography follow-up of the patients would be expensive with increased risk of radiation exposure.

In normal CT colonography follow up in 5 years with CT colonography is recommended. When one or more polyps ≥10 mm in size or three or more polyps 6–9 mm in size found in CT colonography, polypectomy is recommended. One or two lesions with size between 6 and 9 mm should be followed-up with CT colonography every 3 years.

In patients without recurrence of the disease in laboratory or clinical tests, contrast-enhanced CT colonography is accurate for surveillance in colorectal cancer postoperatively. The per-patient and per-lesion sensitivity is 81.8 and 80.8 %, respectively for advanced neoplasia and 80 and 78.5 %, respectively for all adenomatous lesions. The specificity is 93.1 %. The negative predictive values for adenocarcinoma, advanced neoplasia and all adenomatous lesions are 100, 99.1, and 97 %, respectively [12].

62.2.8 Extracolonic Findings

Incidental extracolonic findings are observed with reported rates from 15 to 69 %. Clinically significant findings are found 4.5 to 11 % [13]. Many patients may benefit from detection of previously unsuspected pathology; others may suffer needless anxiety, testing. and cost for clinically insignificant lesions.

62.2.9 Role for Colon Rectal Cancer Screening

Screening using CT colonography as a primary method is feasible. Similar yields for advanced neoplasia are seen in CT colonography, colonoscopy and sigmoidoscopy screening. Crucial factors for the viability of a primary screening test like CT colonography are the impact of extracolonic findings and cost-effectiveness. Good quality data regarding the impact of extracolonic findings and good quality information regarding the cost-effectiveness are lacking. In first round g guaiac Faecal Occult Blood Test/Faecal Immuno chemical Test (FOBT/FIT) positives CT colonography triage is not clinically effective [14].

If widely available, CT colonography may increase adherence to screening as a result of its general acceptance by patients. CT colonography may be the primary screening modality for all patients followed by colonoscopy in the same day if lesions are found. Alternatively colonoscopy may be used for high-risk patients and CT colonography for low-risk patients.

62.2.10 Conclusion

Abdominal CT can accurately indentify liver metastases and locally advanced colon cancer. CT can be used to find lung metastases but not as a routine procedure preoperatively. CT can

identify high risk (T3/T4) tumors with more than 5 mm extramural depth which would be considered as candidates for neoadjuvant therapy.

Recent data show similar detection rates of advanced neoplasia for CT colonography screening and colonoscopic screening. Based on data, CT colonography is an acceptable examination for colon cancer screening which increases the overall prevalence of colon cancer screening. In case of negative for polyps ≥6 mm or cancer initial CT colonography, follow up in 5 years with CT colonography is recommended. Patients with three or more polyps 6–9 mm in size or polyps ≥10 mm in size should be referred for colonoscopy.

Technological advances in multi-detector row CT scanners and computer—aided detection software in addition to stool-tagging low-preparation techniques will allow increase adherence to population-based CT colonography screening.

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