Liver, lung and peritoneal metastases in colorectal cancers: Is the patient still curable? What should the radiologist know

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Abstract Regardless of the advances in chemotherapy, the only curative treatment for colorectal metastases is surgery, which must be complete and excise all of the metastatic sites of disease. Thanks to advances in neoadjuvant chemotherapy and also to alternative techniques, such as radiofrequency ablation, however, surgical treatments have become available to a larger number of patients and have improved patient survival. The aim of this article is to describe the different treatment strategies for colorectal metastases and to examine the role of imaging in defining the resect ability of these metastases. The key factors in the radiological report in the initial and post-chemotherapy assessments are described.

Metastases from colorectal cancer are common and develop in 40 to 60% of the patients. The existence of metastases classifies patients into M1 of the TNM classification and stage IV of the UICC/AJCC classification. External or common iliac lymph node involvement is also deemed to be M1.

The primary metastatic site is the liver. After colorectal cancer has developed, 40 to 50% of the patients will develop liver metastases and synchronous liver metastases, i.e. those present at the time when the colorectal cancer is discovered are found in 15 to 20% of the cases. The cumulative incidence of metachronic liver metastases, i.e. those discovered after treatment for the primary tumor is around 15% at 5 years. The risk of

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developing metastases correlates with the stage of the primary cancer and liver invasion is also a major prognostic indicator and therefore a major treatment challenge. Whilst liver metastases are present in approximately 30% of all patients with colorectal cancer, they are responsible for approximately 2/3 of the deaths [1].

The other sites for colorectal cancer metastases are rarer and include the lungs, peritoneum and pelvic abdominal lymph nodes. These are often combined with liver metastases.

**Treatment strategies**

Preoperative chemotherapy has become a standard treatment in the initial management of patients with metastases. Regardless of the advances in chemotherapy, however, the only curative treatment for metastatic colorectal cancer remains surgery for the primary tumor and the metastases. This surgery must be complete (R0), excising all of the metastatic disease sites. It has become available to a larger number of patients because of advances in neoadjuvant chemotherapy and in surgery and also as a result of alternative treatment techniques, particularly, percutaneous or preoperative ablation therapy techniques. The surgical treatment options for metastases must therefore be considered routinely and reassessed throughout the patient’s management.

**Chemotherapy**

Neoadjuvant chemotherapy

The purpose and choice of neoadjuvant chemotherapy vary depending on the possibilities for surgical resection, which is currently the only curative treatment for metastatic colorectal cancer. Its purpose is to reduce the risk of recurrence and therefore increase overall survival in metastatic disease, which can be resected from the outset, to make the patient operable by obtaining a response in potentially resectable disease and to increase disease free survival in metastatic disease, which has ‘never’ been resectable.

Chemotherapy in metastatic colorectal cancer has changed greatly in recent years with the sequential use of chemotherapy with oxaliplatin (FOLFOX) or irinotecan (FOLFIRI), which have doubled median survival times, increasing from 11 months to approximately 21 months [2,3]. Survival has also recently been improved by the introduction of new pharmacological agents, particularly the biotherapies and with the identification of predictive indicators for treatment response or failure. The addition of bevacizumab or FOLFIRI as the first line treatment increases the likelihood of objective tumor response to 63%, with a median survival of 28 months, which has never yet been achieved in this situation [4]. More recently, cetuximab, an epidermal growth factor receptor (EGF-R receptor) combined with FOLFIRI, has also achieved an overall survival of 23.5 months [5] in first line treatment as a result of determining the tumor KRAS status, which enables a group to be selected which benefits from this treatment.

In order to increase the resectability of metastases (particularly liver), it is now possible to offer selected patients a combination of 3 cytotoxic agents and a biotherapy with bevacizumab or cetuximab. These intensive treatments can achieve response rates of over 70% with tumor control as high as 100% and a resectability rate of approximately 70%, although this is at the cost of significant toxicity.

A new method of chemotherapy administration by slow intravenous hepatic infusion (SIHCA) has been developed to treat colorectal metastases, which are inoperable from the outset and located only in the liver. Hepatic intraarterial chemotherapy requires an intra-arterial catheter to be introduced either by laparotomy or percutaneously by radiology and uses drugs, which have a high, first pass hepatic extraction rate. These enable higher concentrations to be achieved within the tumor and therefore a better response to treatment than the same chemotherapy administered systemically (×5–10 for 5FU, ×4 for oxaliplatin compared to systemic chemotherapy) [6]. The treatment regimen currently used is a combination of intra-arterial chemotherapy (5FU/FUDR, irinotecan or oxaliplatin) and systemic chemotherapy, which achieves particularly high response rates and overall survival rates ranging from 74 to 92% and 20 to 40 months, respectively. IHCA has also been shown to be effective in patients who have failed treatment after several lines of systemic chemotherapy [7]. In particular, the use of oxaliplatin IHCA combined with LV5FU2 has produced response rates of 54% in patients in disease progression after treatment with systemic oxaliplatin [8]. Because of the high response rates obtained, this type of treatment is indicated particularly in patients with single, potentially resectable liver metastases. A recent study in 87 patients with liver metastases deemed to be unresectable and treated with IHCA (oxaliplatin)+LV5FU2 reported a resectability rate of 26% with a significant 56% gain in 5-year survival compared to 0% in the group of patients who were not treated surgically [9]. In another phase II study (the CHOICE study), in 36 patients treated with a combination of intra-arterial oxaliplatin and FU/LV+cetuximab, the response rate was 86% with a resectability rate for liver metastases of 48% (ASCO 2010).

Postoperative chemotherapy

The purpose of postoperative chemotherapy is to reduce the local recurrence rate and to increase progression-free survival and overall survival in patients. This is mostly adjusted in terms of the histological response. If a good histological response is achieved, it is standard practice to repeat the same chemotherapy as was used preoperatively.

**Surgery**

Surgery remains the only curative treatment for colorectal cancer metastases. For this reason, it should be considered routinely and discussed again at the different stages in patient management in a multidisciplinary team meeting. This discussion is based on the risk/benefit balance of surgery, which requires the following criteria to be assessed:

- the patient’s background, whether it is compatible with anesthesia and resection of the metastases;
- oncological restrictions: the total absence of unresectable tumor sites;
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- anatomical restrictions: vascular invasion, sites not enabling parenchyma with its own vascularization to be left;
- technical limitations: the ability to leave a sufficient residual volume in situ;
- tumor chemosensitization: surgery is only indicated in patients who respond or are stable after chemotherapy. Progression on chemotherapy is a contraindication to surgery even if the metastatic lesions appear to be resectable.

Some adverse oncological prognostic criteria (size of metastases 5 cm or over, more than 3 lesions, bilobular liver disease, invaded pedicle lymph node, raised CEA) may be included in the decision as to whether or not to operate. These however are not contraindications to surgery from metastases.

The indications also develop on the number and site of the metastases:

- a single metastatic site: surgery if the lesions are resectable;
- liver + lung: sequential surgery for lesions are resectable: the first excision should be hepatic followed by the lung resection 2 to 3 months later. Combined sequential excision of liver and lung metastases offers a 5-year life expectancy of 25 to 45% at 5 years [10];
- liver + peritoneum: typically this is a contraindication to surgery because of the poor prognosis in these patients although excision surgery may be indicated if only few liver metastases are present (maximum 2 or 3) and are easily resectable. If the peritoneal metastatic lesions are resectable and if metastatic disease is controlled by chemotherapy;
- liver + retroperitoneal lymph nodes: this is a contraindication to surgery. Surgery may be considered if the disease is well controlled over a long period;
- peritoneum + retroperitoneal lymph nodes: this is a contraindication to surgery;
- three or more sites: this is a contraindication to surgery regardless of whether the lesions are resectable.

Liver surgery

Currently, a 5-year survival after surgery ranges from 37% to 58%, with a 10-year survival rate in the region of 20% to 25%. Long-term chemotherapy undoubtedly increases short- and median-term survival, although 5-year survival if surgery is not carried out is very rare. In addition, advances in postoperative chemotherapy have greatly increased the number of candidates for liver surgery, are now in the region of 20 to 30% (compared to approximately 3% previously) [11]. This increase in the number of patients undergoing surgery correlates clearly with the increase in overall survival. It is recommended that if possible patients are operated on as soon as the metastases become resectable without waiting for more than 4 months after chemotherapy, as the maximum reduction in tumor burden is achieved between 2 and 4 months after starting treatment and by leaving a period 4 to 6 weeks after completing chemotherapy before surgery, which reduces the risk of complications.

The definition of resectable liver metastases has changed in recent years. This no longer takes into account the number or size of the metastases but considers the excision of any visible metastasis, which allows at least 20 to 25% of the remaining liver parenchyma to be preserved with its vascular supply and biliary drainage. The concept of resectability varies however between groups depending on surgical expertise and interpretation of the benefit/risk balance. The factors which impact on resectability defined mostly on imaging, are liver function (an indocyanin clearance study), the technical feasibility of surgery, the percentage of residual liver, the number of distant metastatic sites and their resectability and the response to chemotherapy (surgery is not carried out on a patient who progresses on chemotherapy).

Three types of liver surgery are currently carried out:

- simple hepatectomies: right hepatectomy, left hepatectomy and right hepatectomy extended to segment IV;
- complex hepatectomies: central hepatectomy with vascular exclusion, enlarged right hepatectomy (usually to segment IV), segmentectomies and vascular reconstruction;
- two stage hepatectomies (Fig. 1) involve a "cleaning" of the liver lobe or lobes to remain in situ by tumorectomies or percutaneous or surgical ablation of metastases followed by preoperative vascular ligation or contralateral portal embolization to hypertrophy this lobe of the liver. It is important only to carry out portal embolization after excision of lesions in the lobe, which is to remain in situ as the hepatic ischemia caused by embolization leads to secretion of tumor growth factors, which could promote tumor growth and make the lesions unresectable. Finally, contralateral hepatectomy is performed.

Two stage complex hepatectomies are performed in expert centres.

Lung surgery

The indications for this are the same as for liver metastases: surgery is only indicated if complete excision of all metastases is possible ("wedge") (metastasectomy or lobectomy after thoracotomy or sternotomy). Thoracotomy with palpation of the whole lung parenchyma is better for a detailed staging assessment. Peroperative chemotherapy may be used in the same way as for liver metastases.

Peritoneal surgery

As applies to the other metastatic sites, surgery is the only curative treatment for peritoneal metastases. This involves complete resection of the lesions followed by intraperitoneal chemotherapy (ICP) ± hyperthermia (IPCH) (Fig. 2), which achieves a 5-year survival rate of 48.5% and median survival of 60.1 months [12]. Complete surgical cytoreduction is required before administering intraperitoneal chemotherapy as the tissue penetration of chemotherapy molecules is limited to a few cell layers. This treatment combination is only justified if all lesions over 2 mm have been removed. The chemotherapy "bath" can only in reality treat residual disease under or around a millimetre in size. IPCH should be given immediately after the surgery before the residual tumor cells have been trapped in postoperative adhesions. These adhesions form very quickly after the surgical injury and create a true sanctuary for residual tumor...
Figure 1. Liver metastases, which are potentially resectable by two stage hepatectomies. The CT appearances with contrast enhancement over 4 section levels show relatively extensive liver lesions affecting the right lobe of the liver, segment 4 and the left lobe. The management plan involves initially treating the left lobe liver metastases by radiofrequency ablation and then performing right portal embolization and finally a right hepatectomy extending to segment 4.

Figure 2. Surgical treatment of the peritoneal carcinomatosis involves a combination of surgery with complete excision of the tumor sites (a) and intraperitoneal chemotherapy with hyperthermia (b).

cells. IPCH combines the effects of local chemotherapy, allowing concentrations at least 25 times greater than those achieved by systemic chemotherapy with those of hyperthermia, which potentiate the effect of the chemotherapy.

The combination of cytoreduction surgery with IPCH is however a demanding treatment procedure, which is complex and long (usually lasting more than 6 h) and exposes the patient to high risks of dying and postoperative morbidity.
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(0 to 9% and 12 to 68%, respectively) and because this requires exceedingly careful patient selection. It is indicated if the carcinoma is isolated and extension is only moderate in a patient in good general health without organ failure. Criteria, to assess whether surgical indication + IPCH is indicated, are currently being assessed (Table 1) [13]. The main factors to consider are those relating to the extent of cytoreduction surgery (duration, number of anastomoses to be created) and the extent of intraperitoneal extension. In addition to the carcinoma burden the main limitation to R0 excision is the disease distribution in the abdomen and pelvis, which is best assessed from the Sugarbaker Peritoneal Index, which describes extension of the disease into each region of the abdomen and pelvis and also into the small intestine and colon. This index is more accurate than the Gilly Index [14,15]. The score (from 0 to 39) assesses the resectability of peritoneal carcinoma lesions: the higher the score the more extensive resection is required and the risk of death or postoperative complications is high. It is widely accepted for peritoneal carcinomatosis originating from colorectal disease with an index of over 20 is a contraindication to IPCH as the likelihood of completely excising the lesions is extremely low. In addition, some sites may represent contraindications to complete excision. These include mostly the small intestine, mesentery (a residual length of at least 2 m is required for satisfactory quality of life), the stomach and the left gastric blood vessels. Total gastrectomy with IPCH is not recommended and is usually combined with total colectomy. For this reason, any peritoneal carcinomatosis found during laparotomy or laparoscopy should be described in order to determine whether or not excision is possible and if it is, at what cost. In order to assess resectability, surgeons should also look for extra-peritoneal contraindications, particularly, retroperitoneal lymph node invasion and more than 3 not “easily” resectable liver metastases (Fig. 3). Perioperative chemotherapy may be used in the same way as for liver metastases.

### Alterative local treatments

The development of local percutaneous or peroperative heat ablation therapies, either alone or in combination with surgery, has increased the possibility of completely excising metastases, particularly when two stage hepatectomies are indicated and for combined treatment of liver and lung metastases (Fig. 4). These treatments are still indicated for tumors under 3 cm in size. If hepatic radiofrequency ablation therapy is being considered, it is useful to perform a liver ultrasound with or without contrast in order to ensure that the lesions are visible on ultrasound and that the radiofrequency ablation can be ultrasound guided whether it is carried out preoperatively or percutaneously. These treatments, however, are still reserved for situations when complete surgical excision is not possible. When performed alone, they do not enable the more detailed staging assessments to be performed which surgery offers by a full investigation of the abdominal cavity looking for carcinomatosis and a preoperative ultrasound to examine for additional liver lesions. New stereotactic irradiation techniques, which can deliver very accurate and very high irradiation doses to the tumor volume on a non-invasive, ambulatory basis, in 4 dimensions (with respiratory monitoring) by increasing the number of beams, are currently being assessed.

The indications for these need to be considered in a multidisciplinary team meeting in unresectable patients.

#### Table 1 Criteria to assess the indication for surgery (excision + IPCH) for peritoneal carcinomatosis originating from colorectal cancer.

<table>
<thead>
<tr>
<th>Major exclusion criteria</th>
<th>1. Age over 70 years old or WHO2 or more or serious past medical history</th>
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<tr>
<td>2. Extra-abdominal metastases</td>
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<tr>
<td>3. Liver metastases (except if &lt; 3, peripheral and easily resectable)</td>
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<tr>
<td>Minor exclusion criteria</td>
<td>4. Progression on systemic chemotherapy</td>
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<tr>
<td>1. Extensive carcinomatosis either on CT or with major clinical impact</td>
<td></td>
</tr>
<tr>
<td>2. Obesity (BMI &gt; 40)</td>
<td></td>
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<tr>
<td>3. Obstruction</td>
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<tr>
<td>4. Concomitant intra-abdominal metastases other than carcinomatosis</td>
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<tr>
<td>No criteria present</td>
<td>Indication for IPCH → patients to be referred to a reference centre. If synchronous carcinomatosis is present, colectomy is not performed</td>
</tr>
<tr>
<td>One minor criterion present</td>
<td>IPCH may be indicated → contact a reference centre for advice as soon as the diagnosis of carcinomatosis has been made</td>
</tr>
<tr>
<td>One major criterion or 2 minor criteria</td>
<td>IPCH unlikely to be indicated → repeat in assessment at three months and then contact a centre if an objective response to chemotherapy or if criteria have changed</td>
</tr>
<tr>
<td>More than one major criterion or 3 minor criteria</td>
<td>IPCH not indicated → systemic chemotherapy if possible</td>
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Resectability assessment for liver metastases. The CT appearances centred on the liver (a, b, c) show 3 liver lesions, one of which is located at the apex of the left lobe of the liver in contact with the left suprahepatic vein. The CT appearances in the abdomen (d, e) show left ureteric dilatation stopping at a tissue nodule, which is suspicious of the peritoneal carcinomatosis. A PET CT (f) confirmed that this nodule was very suspicious in appearance. Surgery is contraindicated because of the combination of difficult to resect liver metastases and peritoneal carcinomatosis.

Role of imaging in the initial assessment

CT, MRI and PET CT

The initial staging assessment is essential as this guides the treatment strategy by classifying the metastatic disease into disease, which is resectable from the outset, potentially resectable or ‘never’ resectable. The initial assessment should be optimal, establishing the exact number of metastatic sites and lesions before the chemotherapy is started. This assessment is also the key factor in following up patients after treatment.

The imaging assessment relies on chest abdominal and pelvic CT, always including portal venous phase images after contrast enhancement (70 s).

Abdominal MRI is indicated if the least question exists in order to improve characterization of small liver lesions, increase the sensitivity of detecting some poorly reduced density metastases on CT or if inconsistencies are found between different types of investigations (particularly CT
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Figure 4. Liver and lung metastases from a colorectal cancer. The CT appearances (a, b) show a subcapsular liver metastases in segment 6 and a lung metastasis. PET CT (c) was performed and confirmed that no other lesions were present particularly in lymph node or peritoneum. The treatment plan involves initially carrying out hepatic tumorectomy (or "wedge resection") followed by pulmonary radiofrequency ablation. The appearances of the postoperative CT (d, e) show the consequences of hepatic tumorectomy and the area of necrosis induced by the radiofrequency ablation.

Ultrasound and/or FDG-PET CT). The MRI should include T2-weighted images (FSE/TSE) and phase opposition T1-weighted images and both dynamic and effusion weighted images (EG 3D) after contrast [16]. Recent chest abdominal and pelvic CT techniques with diffusion-weighted images are currently being assessed.

FDG-PET CT is useful mostly for extra-hepatic and extra-pulmonary sites. This is usually recommended if metastases
appear resectable on CT from the outset in order to exclude other metastatic sites and also to confirm that the lesions are resectable.

Lung metastases
The reference investigation is CT. This should provide an exhaustive assessment of the number, sites and size of the lesions. Its main difficulty is in characterizing small lesions. Comparison with any previous CTs is extremely useful.

Liver metastases
Imaging should provide a detailed assessment of liver metastases and of their resectability. The assessment should determine:
- the presence and site of any concomitant benign lesions;
- the number of metastases: this is a prognostic indicator but has only a limited influence on the resectability of lesions which is the only possibility for long-term survival;
- the size of the metastases: the percentage of liver invaded by tumors has true prognostic value rather than the size of the tumors themselves. Size, however, is a major factor in assessing the possibility of heat ablation therapy as 3 cm is deemed to be the critical effectiveness cut-off for radiofrequency ablation therapy;
- the site of metastases by vascular territory: right lobe of the liver, segment IV and left lobe. Subcapsular metastases can be treated by tumorectomy (“wedge” resection);
- vascular relationships (portal trunk and branches and hepatic veins) and biliary relationships of the lesions;
- the volume of residual liver in order to assess the need for preoperative portal embolization;
- vascular anatomical variants of the arterial portal and hepatic vein branches. The presence of an inferior hepatic vein in some cases enables a dual V–VI segmentectomy to be performed preserving segments VII and VIII.

If necessary, volumetry of the healthy and diseased liver is performed to assess the percentage of residual liver and the need for preoperative portal embolization. Right portal embolization is recommended if right hepatectomy is indicated and the percentage of residual left lobe of liver is under 25% in order to avoid postoperative hepatocellular failure. Embolization should be performed 30 to 45 days before the hepatectomy.

Peritoneal metastases
CT is still the reference investigation for signs of peritoneal carcinomatosis although its sensitivity for tumor sites is low overall, in the region of 25 to 93% and there is poor inter-observer consistency particularly for tumor sites under a centimetre in size [17–19].

FDG-PET CT is recommended as an addition to CT if peritoneal disease is suspected or when excision surgery + IPCH is indicated in order to increase the sensitivity of detecting tumor sites and therefore extension of the peritoneal disease. Compared to CT, PET CT has the advantage of greater contrast resolution between peritoneal tumors and surrounding structures and better sensitivity for some sites, such as the mesentery, loops of bowel and pelvis [20]. Conversely, it is limited by its spatial resolution which is over 5 mm, possible physiological uptake of the tracer by the stomach and gastrointestinal tract causing false-positive results, movements of the loops of bowel during the acquisition which may lead to underestimated uptake and its poor sensitivity in the right hypochondrium because of physiological uptake by the liver parenchyma and for some histological tumor types, such as mucinous adenocarcinomas, which take up contrast very weakly.

Abdominal and pelvic MR is an option for the staging assessment of peritoneal disease. When this is performed with diffusion-weighted images using sufficiently higher D values (800 or 1000), it improves the sensitivity for tumor sites by suppressing the signals from ascites, gastrointestinal fluid and fat, improving the sensitivity of detecting some anatomical sites which are difficult to assess on CT, such as the right cupula of the diaphragm, the loops of bowel and the pelvis [21]. At present, however, only few studies have been performed in colorectal cancer, which have been analyzed by site [20,22,23].

Regardless of the type of imaging used, it is important to describe whether or not peritoneal carcinomatosis is present and also its extension. Extension of peritoneal disease is one of the major prognostic indicators for resectability in these patients. The other resectability criteria to be looked for on imaging are the presence of mesenteric disease, tumor sites in contact with the gastrointestinal serosa and signs of obstruction or sub-acute obstruction (Table 1).

Role of imaging after neoadjuvant chemotherapy

CT and MRI
The main purpose of imaging is to assess the response to chemotherapy and to reassess the possibility of surgical resection. This assessment should be compared to the previous CT and also to the initial assessment before the chemotherapy was started. It should include a minimum of CT with contrast enhancement in the portal venous phase and it is often useful to add hepatic MRI, which resolves problems of chemotherapy-induced steatosis. The assessment should again describe all of the factors described above to determine whether lesions are resectable.

Metastases classified initially as resectable from the time of diagnosis
It is essential to confirm that the disease has not progressed or that new, particularly, extra-hepatic lesions have not developed. FDG-PET CT is a useful supplement to CT and hepatic MRI in this situation to investigate for extra-hepatic lesions before surgery. Conversely, FDG-PET CT is of no use in assessing response to chemotherapy for liver metastases or in assessing their hepatic resectability.

Metastases classified initially as potentially resectable
The further imaging assessment should define not only response to chemotherapy, but should in particular assess
whether there has been a sufficient response to chemotherapy to enable the metastases to be resected. It is also essential to look for signs of chemotherapy toxicity, which are responsible for an increase in per and perioperative morbidity and mortality. These include steatosis and steatohepatitis and vascular lesions including the sinus occlusion syndrome (SOS syndrome), which may be complicated by portal hypertension and more occasionally by regenerative nodular hyperplasia. A BMI of over 27 or diabetes increases the risk of steatohepatitis.

Some metastases disappear completely on imaging after chemotherapy, in approximately 5% of the patients [24]. It is important to report this type of “missing metastases” when they are located in an area which needs to be preserved during surgery. These lesions, which have disappeared, are then looked for carefully peroperatively by ultrasound, possibly combined with contrast enhancement. It has been shown that surgery for visible lesions leaving lesions which have disappeared (including those which have disappeared on the peroperative ultrasound) in situ, usually combined with postoperative intra-arterial chemotherapy achieves a 5-year survival rate of 40 to 80% [25]. These lesions are deemed to be definitively treated in 62% of the cases.

An alternative if a small metastasis on the initial segment is located in a segment which needs to be preserved during planned surgery and could disappear totally after neoadjuvant chemotherapy is to place an ultrasound guided clip within the lesion before beginning treatment. The lesion can therefore be easily identified during surgery.

**Metastases classified initially as never resectable**

Imaging assesses the response to chemotherapy according to the RECIST 1.1 criteria. A vascular response should also be looked for if targeted therapy has been used.

FDG-PET CT has no recognized benefit in assessing response to chemotherapy for colorectal metastases.

**TAKE-HOME MESSAGES**

**Treatment strategy**

- The treatment of metastatic colorectal cancer has become a complex strategic problem, with many advances, which have resulted in improved patient survival and increasing number of patients treated curatively.
- Many treatment options have emerged and the multidisciplinary team meetings therefore play an essential role in determining the appropriate treatment for each patient. We should not forget that despite the recent advances in chemotherapies and the arrival of the targeted biotherapies, that surgical resection offers the only possibility of a cure.
- The indication for surgery is based on an assessment of the benefit/risk balance and requires assessment of the patient’s underlying condition, the number of metastatic sites, anatomical and technical limitations (blood vessels, residual volume) and chemosensitivity of the tumors. Progression on chemotherapy is a contraindication to surgery.
- If several metastatic sites are present, sequential liver+lung surgery is possible if the lesions are all resectable. Liver+ peritoneal disease is usually a contraindication (except when fewer than 3 easily resectable liver metastases are present). Liver + lymph node disease or disease involving 3 or more sites is a contraindication to surgery, regardless of whether the lesions are resectable.

**Clinical case**

This 59-year-old female patient is being followed-up for late metastases of a colonic cancer treated surgically 18 months ago. A chest, abdominal and pelvic CT showed no abnormalities apart from liver metastases and a complimentary liver MR was performed (Fig. 5).

**Question**

1. Describe the appearances as in a full imaging report.
2. Are the lesions resectable or not? Justify your answer.
3. What type of treatment would you propose?

**Answers**

1. The T2-weighted images (Fig. 5a–b) show 3 lesions suggestive of metastases: a lesion approximately 40 mm in size in segment VIII adhering to the right hepatic vein, a
lesion in segment V, a lesion and small centimeter size lesion in the left lobe of the liver. The phase (Fig. 5c) and phased opposition (Fig. 5d) T1-weighted images show a large fall in non-tumor liver parenchymal signal in phase opposition, indicating diffuse hepatic steatosis, which is slightly heterogeneous. The patient is also considerably overweight. The contrast-enhanced image in the venous phase (Fig. 5e) shows an accessory right inferior hepatic vein.

2. The patient has bilobar metastases although there are few of these and they are small apart from the lesion in the dome of the right side of the liver. A single lesion is present in the left lobe: this is small in size and located beneath the capsule and as a result tumorectomy or radiofrequency ablation therapy can be considered. The metastases are therefore resectable from the outset.

3. Surgery should therefore be offered for the liver metastases in the absence of extra-hepatic metastases. The existence of overweight and hepatic steatosis increases the morbidity of hepatectomy and should encourage surgery to be as conservative as possible. The presence of an accessory inferior right hepatic vein enables a VII and VIII bi-segmentectomy to be considered, leaving segments V and VI in situ. The metastases in segment V and the left lobe are less than 3 cm in size and should be treated by peroperative radiofrequency ablation.

Figure 5. T2-weighted images (a, b), T1 phase image (c), T1 phase opposition image (d), enhanced T1 image in the venous phase (e).
Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

References


