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Review

Interventional radiology in breast cancer

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ABSTRACT

Molecular profiling of metastatic disease may greatly influence the systemic therapy recommended by oncologists and chosen by patients, allowing treatment to be more targeted. Comprehensive care of patients with advanced breast cancer now includes percutaneous image-guided biopsy if this has the potential to influence systemic treatment [1]. Interventional radiologists can contribute significantly to the care of patients affected by breast cancer, in diagnostic and supportive procedures and importantly also in treatment. Interventional radiologists carry out image guided percutaneous biopsies not only of the primary tumour but also of metastases. They insert percutaneous ports and tunnelled central venous catheters. They ablate painful bone metastases, and can treat or prevent pathological fractures. Most importantly they can ablate liver metastases in patients with limited or oligometastatic disease. The inhomogeneity and variety of cell populations in metastatic tumours from breast cancer, which is an important consideration in systemic therapy, is not an important consideration in the treatment of metastatic tumours using percutaneous ablative techniques, which are the major focus of this article. The treatment of primary tumours in the breast is also being explored, but is considered in its infancy at this stage.

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1. Hepatic metastases

Two-thirds of women with metastatic breast cancer will eventually develop liver metastases. The liver is the third most common site of metastatic spread after the bone and lung. A limited number of patients present with apparent liver only metastases (12–16%). A

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larger group of patients have stable bone metastases and hepatic metastases. As advances in systemic therapy have produced increasingly better results, there has been a trend towards a more aggressive treatment of this patient group. The decision as to whether to treat hepatic metastases as an adjunct to systemic treatment with surgery, radiotherapy or ablative interventional techniques is a complex one. In patients with metastases only in the liver, it may be possible to defer the use of chemotherapy if the liver metastases are eliminated, until such time as there is progressive disease. The choice of adding local liver treatment in the setting of widespread metastatic disease is more complex. Local therapy to limited progressive liver lesions could be considered in patients whose disease is otherwise indolent, with a chronic course. In patients with widespread metastatic disease, palliation of a painful liver metastasis should be considered.

Hepatic resection is less well-established in patients with carcinoma of the breast, as it is seen as too invasive in patients who often have extrahepatic disease. However, some patients with apparently isolated hepatic metastases have benefitted from surgical resection.

Adam et al. reviewed outcomes for 85 consecutive patients with breast cancer liver metastases treated with hepatic resection [2]. At a median follow-up interval of 38 months, 32 patients were alive, yielding median and 5-year overall survivals of 32 months and 37%. Median and 5-year disease-free survivals were 20 months and 21%. The authors concluded that the dogma that surgical therapy has no role in the treatment of cancer patients with apparent systemic disease spread (i.e., metastatic breast cancer) is no longer valid. When included in the multimodality treatment plan, hepatic resection can be performed with low risk and can improve long-term outcomes, provided that resection is macroscopically complete. In highly selected patients, surgical therapy can act as an effective adjunct treatment to systemic therapies and can provide them with a survival benefit.

At least three observational studies directly comparing outcomes of surgically treated patients with pulmonary or hepatic metastases with those receiving chemotherapy alone suggest a significant survival advantage for surgery [3–5].

As small tumours are increasingly detected with modern imaging techniques, percutaneous ablation should play an important role in local disease control in patients with metastases only in the liver, because it is less invasive than surgery. Surgery should only be considered if ablation is not technically feasible. Ablation is usually preferred by the treating team, as the timeframe for recovery is short, providing less morbidity for patients and interfering minimally with the delivery of systemic treatment.

Moreover, minimally invasive techniques for local ablation of hepatic metastases may also provide reasonable alternatives for patients who are not candidates for surgery. Such techniques include cryotherapy and thermal ablation with microwaves or radiofrequency.

1.1. Thermal ablation

Radiofrequency radiation and microwaves produce local heat in tissues. Needle-like electrodes are placed percutaneously directly into the tumour, with the use of ultrasound, computed tomography (CT) or magnetic resonance imaging (MRI) guidance. The latter modality offers the possibility of monitoring with MR thermometry; however, this has not shown to be clinically useful. MRI guidance is cumbersome and expensive and is used rarely. Ultrasound guidance is inexpensive, widely available and can provide real time guidance for a safer electrode placement. However, many interventional radiologists prefer CT guidance because of its greater accuracy and clearer demonstration of adjacent organs. “Fusion imaging” is growing in its applicability and can facilitate the targeting process. The simultaneous use of CT and US may overcome the limitations of both techniques.

1.1.1. Patient selection and procedural technique

The goal of thermal ablation is to destroy the tumour as well as a 5–10 mm circumferential cuff of adjacent normal hepatic parenchyma. Each ablation requires exact placement of the electrode tip in the tumour. A single ablation treatment raises local tissue temperatures to 60°-100 °C and produces a spherical thermal injury approximately 3–5 cm in diameter. Tumours smaller than 4 cm in diameter can be treated with one or two ablations. However, tumours greater than 4 cm require several overlapping ablations. Each ablation usually lasts 8–12 min and two or three ablations can be carried out during the same session.

Initially, most investigators are limiting treatment with thermal ablation to patients with four or fewer, 5 cm or smaller, primary or secondary malignant hepatic tumours, with no evidence of extrahepatic disease. However, more recently, patients with a small number of pulmonary metastases or with stable bone metastases are increasingly being offered treatment, as such metastases do not usually have a significant impact on survival. Ideal tumours are smaller than 3 cm in diameter, completely surrounded by hepatic parenchyma, 1 cm or more deep to the liver capsule, and 2 cm or more away from large hepatic or portal veins. Subcapsular liver tumours can be ablated, but their treatment is usually associated with greater procedural and post-procedural pain if not accurately performed with dedicated technique such as hydro or pneumodissection. Subcapsular tumours can be treated with laparoscopic ultrasound guided thermal ablation. Tumours adjacent to large blood vessels are more difficult to ablate completely with radiofrequency because the blood flow in the vessels causes loss of heat, thus limiting the extent of the ablation. This is the ‘heat sink effect’. Microwave ablation is less prone to this problem. Ablation of tumours adjacent to large portal triads causes increased pain and poses the risk of damage to the associated bile duct. Contraindications to treatment include sepsis, severe debilitation, and uncorrectable coagulopathies.

Percutaneous thermal ablation is often carried out with the use of conscious sedation alone although some investigators routinely employ general anaesthesia. The procedure can be performed on an outpatient basis, but most interventional radiologists prefer to keep the patients in hospital overnight, partly in order to treat any discomfort and partly because of the small risk of haemorrhage accompanying the procedure.

Major complications are unusual. The main ones are intraperitoneal haemorrhage, liver abscess and seeding along the tumour tract. There is often some pain after the procedure, but this usually settles within 24 h. Approximately 10–20% of patients have a 1–3 °C rise in temperature, as a response to tumour necrosis; this mild pyrexia usually begins the day after the procedure and can last up to a week. However, prolonged, marked pyrexia should always raise the suspicion of infection and merits further investigation.

1.1.2. Assessment of treatment effectiveness

CT and ultrasound cannot give a reliable feedback during the ablation process, although contrast-enhanced ultrasound and enhanced CT may provide an indication of residual disease and help to decide whether further treatment is necessary.

MR has the potential of measuring temperature and providing “online” monitoring, but this capability is limited by several other practical considerations, including the difficulty of using radiofrequency or microwaves in an MR machine.

In practice, patients are followed up with contrast-enhanced CT or MR carried out the day after the procedure or later. Remaining