Percutaneous treatment of liver metastases

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Hepatic resection is the mainstay in the curative management of primary and secondary hepatic malignancies. It offers the only proven chance for cure of both primary and certain metastatic liver tumours. Actuarial survivals achieved in patients undergoing resection for hepatocellular carcinoma range from 55%-80% at one year and 25%-50% at five years (1,2,3). Similar outcomes have been achieved with the resection of colorectal hepatic metastases (4).

Although surgical resection has significantly improved survival in operated candidates, only a minority of patients are surgical candidates because of tumour volume, lesion location, extrahepatic metastases or, in the case of hepatoma, limited hepatic functional reserve secondary to associated cirrhosis.

Percutaneous liver tumour ablation

Percutaneous techniques of local tumour ablation may be categorised into three major groups : injectables (ethanol, acetic acid, hot saline), heating (radiofrequency, electrocautery, interstitial laser therapy, microwave coagulation therapy, and high intensity focus ultrasound), and freezing (cryotherapy). Of these the most widely used are percutaneous ethanol injection for hepatocellular carcinoma and thermal ablation methods for hepatic metastases.

Percutaneous ethanol injection therapy

Percutaneous ethanol injection therapy (PEIT) was first described in 1983 (5). Since that time PEIT has been used extensively for treatment of unresectable hepatocellular carcinoma (6,7). There is no absolute limitation to the size or number of lesions treated. However, as tumour size increases, homogeneity of ethanol diffusion diminishes at the periphery, increasing the probability that residual viable tumour cells will persist at the margin of the lesion following therapy. The limitation of diffusion radius and homogeneity is particularly relevant to metastases that have a firmer consistency than hepatocellular carcinoma, making them more resistant to ethanol diffusion at any size. The frequent need for multiple treatment sessions per lesion, and the limited injection volume tolerated in a single session, place practical limitation on the number of lesions treated. For these reasons, as well as the documented greater effectiveness of PEIT for solitary tumours 3 cm or less in diameter, many authors have restricted PEIT to nodular lesions 3 cm or less in diameter and three or fewer in number. Others have used PEIT for tumour nodules up to 5 cm in size and up to four in number. Techniques such as insertion of multiple needles into different parts of large lesions, and single-session, high-dose therapy under general anaesthesia, have been used to overcome these limitations and extend the applicability of PEIT to lesions as large as 9 cm, patients with as many as five nodular lesions, and even neoplasms with infiltrating morphology (8,9).

Thermal ablation

Lesional heating techniques such as radiofrequency (RF) ablation and interstitial laser photocoagulation (ILP) affect tumour necrosis for hyperthermia. RF electrodes or laser fibres are inserted into the tumour under ultrasound, CT or MRI guidance. They generate intralesional heat by local hyperthermia which has been shown to cause almost immediate coagulation necrosis at temperatures of 60° C or greater, and to have a preferential cytotoxic effect on tumour cells at temperatures between 41° and 45° C. The time required to achieve a cytotoxic effect at these lower temperatures ranges from 15 minutes at 45° to 240 minutes at 41°, with the time doubling for each degree drop in temperature (10,11,12).

Radiofrequency waves induce ionic agitation, which results in frictional heat production within the tissue. The size and shape of the necrotic lesion produced by RF has been shown to a function of the probe gauge, length of the exposed probe tip, temperature along the exposed electrode, and duration of therapy. Lesion diameter increases with local temperature up to 90° and reaches a maximum of 1.6 cm for a single probe. Strategies aimed at increasing the volume of tissue coagulation include the use of multi- probe electrodes and saline enhancement (13). The procedure is well tolerated and causes either no or only slight and transient elevations of liver function tests. Serious complications are rare and consist mainly of intraperitoneal haemorrhage and liver abscess formation.

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Interstitial laser photocoagulation (ILP) produces thermal coagulation by conversion of absorbed light energy into heat. Conduction and convection of heat extends the cytotoxic effect beyond the 8 mm of light penetration into surrounding tissues reaching a plateau of 16 mm in diameter at 2W and 600J. Utilising a 1 × 4 coupler to achieve simultaneous activation of four fibres placed 1.5 cm apart, it is possible to create a single coalescent necrotic lesion measuring approximately 3 × 3 × 3 cm in most cases (14).

The follow-up of patients after all forms of percutaneous tumour ablation includes a combination of imaging, tumour marker assay, and selected use of fine needle aspiration biopsy. It is useful to follow serial levels of alpha-fetoprotein or carcino-embryonic antigen, in the case of hepatocellular carcinoma or metastatic disease respectively, only when the serum levels of these markers are elevated prior to the initiation of therapy. The immediate goal of imaging is to assess whether complete necrosis has been achieved. Ultrasound does not usually provide useful information, as the echogenicity of fibrosis and neoplastic tissue overlap. Contrast enhanced-MRI and contrast enhanced-CT are capable of demonstrating remaining viable tumour requiring treatment. However, in difficult cases, PET scanning may provide additional information.

Better methods of imaging guidance and more sophisticated equipment are likely to increase the importance of percutaneous tumour ablation in the future.

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