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Combined microwave thermal ablation and liver resection for single step treatment of otherwise unresectable colorectal liver metastases; a monoistitutional experiences

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Abstract. – OBJECTIVE: Over half of colorectal cancer patients will develop liver metastases.

BACKGROUND: Thermal ablation with or without associated liver resection for colorectal hepatic metastasis has been suggested as an alternative method to improve survival if radical surgical resection is not achievable. A retrospective case series of patients treated with microwave ablation(MWA) associated with hepatic resection in one step procedure, was reviewed to analyze the clinical outcome.

MATERIALS AND METHODS: In a group of 40 patients surgically cured for liver tumors in our Department, 5 patients with technically unresectable disease underwent combined treatment LR-MWA.

RESULTS: Four patients were treated with multiple segmentectomies and MWA and one patient received a left lobectomy (S2-S3) and MWA. Only 1 patient (20%) developed post surgical complication which was a liver abscess (grade II of Dindo classification).

CONCLUSIONS: Hepatic resection combined with MWA expanded indications for operative treatment of multiple bilobar liver metastasis. This procedure promise to have good long-term outcomes.

Key Words:
Liver metastasis, Colorectal cancer, Microwave, Thermal ablation, Liver resection.

Introduction

Metastatic liver disease is more common than primary liver cancer and develops when malignant cells migrate from other organs to the liver, that is the second more common tumor aim than lymph nodes in metastatic disease. More than 50% of patients will die for metastatic complications.

Hepatic resection is the only form of treatment that currently offers a chance of long-term survival for patients with colorectal liver metastases (CRLM)[1].

Only 20% of patients with CRLM are candidates for resection, other patients are excluded from this method of treatment because of multiple metastases, anatomical limitations, inadequate functional liver reserve, extrahepatic metastases, or medical comorbidities.

Traditional limits to hepatic resection have been exceeded as advancement in technology and surgical technique enable safe resection of up to 80% of the functional liver parenchyma with a mortality of 5% or less in major centers[2,3].

Actually ablative treatment as mw (microwave), offer an efficient alternative for patients excluded to surgery. Mw coagulator generates and transmits mw energy to the electrode with coagulative necrosis causes cellular death and destroys tumor tissue, resulting in reduction of tumour size. A curative treatment of CRLM is considered possible in only 15% of patients with liver metastases[4].

Literature evidences that chemotherapy-first approach, is the best neoadjuvant treatment to CRLM, valuable not only for the initially unresectable lesions, but also for resectable ones and shown a significantly better prognosis in combination with liver resection for this cohort of patients. Technical progress carried out several alternative or adjunctive methods of treatment including chemotherapy and local ablative treatment.

Neoadjuvant chemotherapy, preoperative portal vein embolization or two-stage hepatic resections increase the number of patients eligible for potentially curative treatment[5,6].

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Chemotherapy can be delivered intra-arterially (5-fluorouracil), and it is called "regional chemotherapy", or it can be delivered systemically (5-fluorouracil, irinotecan, oxaliplatin, leucovorin, capecitabine).

Local tumour ablative techniques include transarterial (chemo)embolisation, percutaneous ethanol injection, microwave coagulation, laser-induced thermotherapy, radiofrequency ablation, and cryosurgical ablation.

Microwave coagulation involves placing an electrode into a lesion under ultrasound or computed tomography guidance. The microwave coagulator generates and transmits microwave energy to the electrode. An alternating high frequency (up to 2450 MHz) electromagnetic wave causes molecular vibration of dipoles, which produces heat and thermal coagulation around the electrode. Coagulative necrosis causes cellular death and destroys tissue in the treatment area, resulting in reduction of tumour size.

The most widely employed method is radiofrequency ablation, and literature shown that patients with unresectable tumors, have generally a poor prognosis with 3-24 months of survival, and palliative treatment are usually offered[7].

Despite these innovations, many patients still are not candidates for complete operative resection.

One the most serious surgical problems in patients with colorectal liver metastases, is the presence of bilobar lesions and as a consequence of radical treatment the impossibility to leave sufficient residual functional hepatic parenchyma.

In order to increase treatment options for patients with unresectable bilobar disease there is growing interest in ablative technologies for localized tumor destruction[8].

Recently, several interstitial ablative techniques such thermal ablation as radiofrequency or microwave, have shown promises in the treatment of unresectable liver cancers[9].

Ablation combined with resection has also been suggested as an option for patients in whom complete surgical resection is not possible for small hepatic remnant volume[10,11].

In patient with bilobar disease, dominant lesions can be resected whilst contralateral lesions that cannot be resected are ablated.

However, resectability criteria for multiple bilobar liver metastases and indications for the combined resection/ablation strategy are different among centers.

In patients with liver metastases, local or regional treatment methods can provide local control, but it is uncertain what long-term outcomes can be anticipated with some of these therapies. Systematic reviews may help to establish the effectiveness and the tradeoffs between benefits and harms associated with different non surgical ablation methods for the treatment of all forms of malignant liver tumours.

To assess efficacy of an alternative treatment option in single step procedure combining microwaves ablation with surgical resection for CRLM we retrospectively investigated our single center experience on this topic.

Patients and Methods

In a cohort of 40 patients treated surgically in our Department for different liver tumors, 5 of them affected by CRLM were submitted to so-called "chemo first approach".

They were 5 females affected by bilateral CRLM, mean age was 60 years, as shown in Table I. After Chemotherapy they were all judged at risk for surgical radical liver resection and then considered for the combined approach surgical liver resection and microwave ablation of residual metastases LR-MWA.

Main reason for denying surgery to these patients were poor remnant liver volume (RLV) and chemotherapy associated liver injury (CALI).

Mean duration of chemotherapy with FOLFOX regimen was 6 months.

Again the use of microwave ablation in combination with hepatic resection was confined to patients for whom no resection could be designed to permit complete resection of neoplasms while preserving sufficient vascularized hepatic parenchyma to avoid hepatic failure.

Often these patients were submitted to long series of chemotherapy treatments that determined hepatic parenchimasteatosis and steatohepatitis that compromised hepatic liver function. In these patients pre-operative liver and tumoralvolumetry were studied with the CT scan.

Therefore, microwave thermal ablation was used as a component of therapy when patients were considered unresectable.

Parenchymal transection was performed using radiofrequency dissector.

Intraoperative ultrasound (IOUS) was routinely performed:

1. To identify occult neoplasms not detected preoperatively and to confirm relationships between neoplasms and vasculobiliary structures.

2. to guide placement of the ablation needle into lesions to be ablated by microwave. For this purpose we used Amica 200 mm needle probe of 14G.

The first ablation started at the location farthest away from the skin puncture site. After the ablation was completed, the needle was withdrawn to the second predetermined location. Complete ablation (CA) was defined as uniform US hypoattenuation by tumor necrosis.

Results

Mean diameter of ablated lesion were 5.4 (range 3.5-7 cm), with mean time of ablation procedure of 15 minutes (range 12-19 min).

In all 5 cases only one cycle of microwave ablation was performed (mean time of ablations was 10 minutes), aiming to obtain at least a 1cm zone of treatment beside the liver tumor).

CA was obtained in 100% of cases, and procedures were combined four times with multiple segmentectomies and once with left lobectomy (S2,S3).

As post operative complications we registered only 1 patient (20%) which developed a liver abscess (Grade II a Dindo-Clavien Classification) in the ablated site conservatively treated.

No other clinically relevant complications, such as bleeding, subcapsular hematoma, bile duct injury, or burn injury of the skin, were noted during the follow-up period. None of the patients in this study developed local dissemination of cancer cells along the electrode puncture line. Our clinical series demonstrate favorable responses and long-term survival following for patients with metastatic tumors, after 12 months follow-up 100% of patients are alive.

Discussion

Although surgical resection is the only potentially curative approach for patients with primary and metastatic liver tumors, most patients with hepatic malignancy are precluded from resection due to multifocal disease, anatomic limitations, inadequate functional liver reserve, extrahepatic metastasis or medical comorbidities. Consequently, several methods of tumor ablation have been developed as alternate treatment strategies for patients with unresectable hepatic tumors or as adjuncts in total cancer therapy.

For the treatment of CRLM there is still an open debate regarding the achievement of the gold standard, although complete surgical resection represents the only real cure[12]. In the setting of the alternative palliative approach such as thermal ablative methods radiofrequency ablation has known limits named size of metastases (lesions bigger than 5 cm)[13,14]. While several experiences has shown the feasibility of treatment using microwaves ablation for lesion up to 7 cm[15]. In addiction, proximity to vascular structure is not considered a problem with microwaves and overall there are less cycles of intra operative treatment and the length of procedure is much shorter. Our preliminary experience confirmed it and found this combined approach useful especially in patients affected by bilateral disease with important liver damages due to neoadjuvant chemotherapy.

Bilateral CRLM is a complex oncological situation and many strategies such as 2 staged treatments with integration of neoadjuvant or adjuvant chemotherapy have been proposed[16]. Generally in this complex scenario oncologists are more and more proposing “chemo first” approach for CRLM[17]. However, the present strategy has in our opinion some advantages like:one step treatment, less liver failure risks, possibility to live more space to furtherchemotherapic aggressive regimens. In the era of two-steps strategy surgical proposals, this advantageous combination should be taken into account in selected cohorts of patients, in which liver was previously damaged by aggressive chemotherapy regimen or with fibrotic liver due to concomitant diseases.

Conclusions

Microwave ablation combined with surgical liver resection for CRLM is an emerging safe approach alternative to traditional radiofrequency ablation associated to hepatectomies.

Advantages seem to be no heat sink effect, bigger diameter of treatable lesions, time spare, effectiveness and safety of procedure, all in one step treatment.

This combined approach can be promising in high risk patients for radical surgical resection due to small or diseased future remnant volume and those cases are going to be more and more frequent in the era of the “chemo first” approach. Microwave probe can produce clinically usable coagulation diameters without undesired exten-

sion of coagulation along the shaft and may prevent collateral damages like skin burn during ablation. Furthermore, LR-MWA overcomes the limits of radiofrequency ablation and is an alternative to other proposed strategies like (liver first approach, two-stages procedure with portal embolization, ALPPS), especially in patients refusing 2 operations.

Moreover, this kind of approach could be used in so called frail patients i.e. elderly and HIV-positive patients[18-31].

Conflict of Interest

The Authors declare that they have no conflict of interests.

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