Tumorous necrotic nodule in the liver: unexpected effect of the microwave tissue coagulator

Yoshiki Mikami, Michio Shimizu, Toshiaki Manabe

Abstract

The microwave tissue coagulator (MTC) is used in hepatectomy because it provides excellent haemostasis during the procedure. A 59 year old man underwent partial hepatic lobectomy with MTC, for metastasis from colon cancer. A tumorous necrotic nodule was discovered in the liver. The nodule measured 2.5 cm at its largest diameter. Microscopically, it showed extensive coagulation necrosis and massive sinusoidal dilatation. To date, such a necrotic mass clinically mimicking neoplasm has not been reported as a complication of hepatectomy using MTC. Although it is unknown how the rounded necrotic nodule was formed in this case, clinicians should be aware of this phenomenon to avoid unnecessary operations. Likewise, pathologists should recognise such histological changes and review the clinical history of the patient when coagulation necrosis with massive sinusoidal dilatation is observed in a biopsy or hepatectomy specimen.

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The microwave tissue coagulator (MTC) is used in hepatectomy because it provides excellent haemostasis during the procedure. The microwave energy, acting on the polarities in water molecules in the biological tissue, generates heat that causes tissue coagulation and haemostasis.^{1,2} Clinical evidence indicates that this device has therapeutic applications in the ablation of hepatocellular carcinomas,³⁻⁵ and the treatment of spontaneous rupture of hepatocellular carcinoma with massive haemorrhage.⁶ To the best of our knowledge, no notable side effects of MTC have been reported. Recently, we noted a necrotic nodule in a liver considered to be caused by this device. Our objectives are to alert clinicians to the existence of this unexpected complication and to describe the morphological features of the lesion.

Case report

A 59 year old man, who had a right hemicolectomy performed for advanced cancer of the ascending colon 18 months previously, was admitted to our hospital because of suspected metastatic tumour in the posterior portion of the left lobe of the liver. At that time partial

hepatic lobectomy, using the MTC, was performed with the pathological confirmation of metastatic adenocarcinoma and free resection margin. The MTC used (Microtaze OT-110M, Heiwa Electronic Inc, Ltd, Osaka, Japan) consisted of a microwave generator, flexible coaxial cable, and a needle-like monopolar electrode 3.0 cm long. The microwaves were generated at a frequency of 2450 MHz and wavelength 12 cm by the magnetron generator with an average output of 60 W, and transmitted to the electrode through the coaxial cable to irradiate the tissue. The electrode was inserted for 30 seconds repeatedly along the resection line. The ultrasonography performed immediately after the operation demonstrated no evidence of residual tumour.

Figure 1 (A) Computed tomography demonstrating a well circumscribed round low density area, 3.5 cm in largest diameter, located in the posterior portion of the right hepatic lobe adjacent to the resection margin left by the previous operation. (B) The resected liver tissue, when bisected and partially opened, showing a well demarcated round area, white to grey in colour, measuring 2.5 cm in largest dimension (arrow). A zonal discoloured area, with a thin congested area at the junction with the normal hepatic parenchyma, is seen along the new resection margin (arrowheads).

Department of
Pathology, Kawasaki
Medical School, 577
Matsushima,
Kurashiki, Okayama
701-01, Japan

Correspondence to:
Dr Mikami.

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Figure 2 (A) Tumorous necrotic nodule of the liver. Low magnification, showing numerous cystic vacuolations in a background of extensive coagulation necrosis with preserved outline of the normal liver parenchyma. (B) Higher magnification, demonstrating dilated spaces adjacent to widened sinusoids within relatively viable area (haematoxylin and eosin).

Two months later, computed tomography (CT) demonstrated a rounded low density area, measuring 3.5×3.0 cm, adjacent to the previous resection margin of the liver (fig 1A). The physicians interpreted this area as a residual metastatic tumour, and carried out a partial resection four months after the first hepatectomy, again using the MTC. The removed tissue was submitted to the pathology laboratory. Although ultrasonography and CT disclosed evidence of metastatic deposits within the remaining liver, the resection margin of the liver did not show notable changes. Eight months later, the patient died from dissemination of the carcinoma, permission to perform a necropsy was not granted.

Histological findings

The resected liver tissue measured $8 \times 7 \times 4.5$ cm. On sectioning, there was a well circumscribed white-grey round necrotic mass,

measuring 2.5 cm in largest diameter, adjacent to the resection margin left by the previous operation (fig 1B). In addition, a discoloured zone 0.5–1 cm wide was present along the current resection margin, which the records entered by the attending surgeon indicated to have received direct effect of the MTC. There was no continuity between this discoloured area and necrotic mass.

Microscopically, the well circumscribed mass showed extensive coagulation necrosis with preserved outline of the normal liver parenchymal architecture and a large number of cystic vacuolations throughout the area (fig 2A). Within relatively viable areas these cystic spaces, intervened by hepatic cords, were continuously adjacent to slightly widened sinusoids (fig 2B), thus interpreted to be massive dilatation of sinusoids. Silver impregnation staining highlighted this architectural alteration. At the periphery of the mass, there was a fibrous capsule composed of irregularly arranged fibroblasts and collagen fibres with scattered lymphocytes and histiocytes. Aggregates of foamy histiocytes mingled with lymphoplasmacytic infiltration were seen at the junction between the necrotic and fibrous areas. Although entrapped arteries within the capsule were occluded by intimal fibrosis, neither thrombosis nor disruption of the vessels was observed in the liver tissue surrounding the necrotic area.

A discoloured zone along the new resection margin contained relatively viable liver parenchyma with markedly dilated spaces as seen within the necrotic mass. These spaces were lined by viable flat endothelial cells, and were regarded as sinusoids. Meticulous examination failed to disclose any residual tumour tissue within the resected liver tissue.

Discussion

In this case, the rounded low density area disclosed by CT scan adjacent to the resection margin, was erroneously interpreted as a metastatic adenocarcinoma. However, microscopic examination of the mass revealed extensive coagulation necrosis surrounded by a fibrous capsule. We interpreted this coagulation necrosis as a consequence of tissue damage caused by the MTC during the first hepatectomy for the following reasons: the CT scan obtained just before the first hepatectomy did not show any lesions in the area corresponding to the necrotic nodule; the presence of granulation tissue surrounding the necrotic area indicated that this lesion had already been formed before the second hepatectomy; and the architectural alteration, namely dilatation of the sinusoids observed within the necrotic area, was also seen in the discoloured area that the surgeons had noted to appear following microwave coagulation during the second hepatectomy. We attempted to verify whether necrosis was also present in liver tissues from other patients treated at our hospital using the MTC. Our review of histological slides from five such cases revealed similar changes in the zonal area of degenerated parenchyma ranging from 0.5–0.8 cm in width, along the resection margin,

although the viability of the liver parenchyma was variable in areas. In all cases, sinusoidal dilatation was prominent within degenerated areas.

MTC is asserted to be safe,^{4,5} and serious complications have not been reported to date. Therefore, our case is important in that it documents that a necrotic nodule, which clinicians may mistake for neoplasm, may be a complication of this technique. Microwave coagulation induced necrotic nodule should be included in the differential diagnosis of liver masses presenting as a low density area on CT to avoid an unnecessary operation, especially in a patient with a previous history of hepatectomy using MTC.

It is not clear why such a large necrotic nodule was formed in the present case. The MTC had been used in the standard manner so that an area of necrosis should be about 1 cm in breadth around the electrodes. In this context, we are tempted to speculate that vascular occlusion from thrombosis or vascular injury caused by the MTC might have played a critical role in secondary extension of necrosis into the deeper portion of the liver. Alternatively, there may be a technical explanation. The electrode is usually inserted parallel to the intended direction of resection. If the electrode were tilted, the microwaves might strike a portion far from that originally planned. The latter possibility is tenable, but it will remain speculative until further evidence is gathered.

The hitherto described histopathological changes of the liver caused by the MTC are coagulation necrosis,⁷ severe nuclear degeneration, and swelling and vacuolar change of hepatocytes adjacent to the necrotic area.³ Massive sinusoidal dilatation as seen in our patient has not been noted to date. However, this finding is not entirely specific for the MTC, and is sometimes seen in cases of metastatic carcinoma, Hodgkin's disease, and a variety of granulomatous diseases. In these conditions mechanical obstruction of blood flow by granulomas and neoplastic tissue are considered to result in sinusoidal dilatation.⁸ Some authors regard massive sinusoidal dilatation as an initial stage of or mild form of peliosis hepatitis because of the common underlying

disorders noted in both lesions.⁹ Zafrani *et al*¹⁰ discussed the possible pathogenetic mechanisms of peliosis hepatitis, citing sinusoidal wall injury caused by toxic agents, hepatocellular necrosis destroying the reticular framework and causing inflow of blood from adjacent sinusoids and consequent cystic dilatation, blockage of blood flow at the junction between the central venules and sinusoids, and congenital malformation or angiitis. The mechanism by which the sinusoidal dilatation arose in the necrotic area in our patient is unclear. However, it cannot be denied that the heat induced by the microwave energy might have played a critical role in its genesis.

In summary, we describe a tumorous necrotic nodule of the liver arising in a patient who had undergone partial hepatic lobectomy using the MTC. Clinicians should be aware of this rare complication, and pathologists should be aware that extensive hepatic necrosis with massive dilatation of sinusoids may be an adverse consequence of MTC, which is increasingly selected for hepatic surgery or ablation therapy for hepatic tumours.

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