

High-intensity focused ultrasound as a treatment for colorectal liver metastasis in difficult position

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Accepted: 3 August 2011

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Dear Editor:

Liver metastasis in patients with colorectal cancer is not uncommon. Synchronous liver metastasis can be detected in 15–25% of the patient population. Metachronous liver metastasis can happen in 40–50% of the patients who have received surgery for its primary cancer. With the advancement of laparoscopic colorectal surgery, most of the patient are now receiving curative resection by minimally invasive approach resulting in an early recovery and virtually invisible wound. However, laparoscopic liver resection and ablation for liver metastasis still have their limitations. Major hepatectomy by laparoscopic means is feasible, but it still requires a large incision for specimen delivery. Laparoscopic radiofrequency ablation can tackle most of the tumour in the liver, but ablating a tumour at the dome of the liver or lesion near the inferior vena cava can be technically difficult if not impossible. High intensive focused ultrasound (HIFU) is a relatively new technique and is a totally extracorporeal non-invasive ablative treatment method using focused ultrasound energy that is capable of producing coagulation necrosis of the targeted HCC via intact skin without the need of surgical incision. It can reach all parts of the liver as long as the lesion can be localised by the ultrasound.

A 53-year-old patient who presented with left side abdominal pain for 3 months was admitted to our hospital. Complete blood picture showed that his haemoglobin level was 10 g/dL. Colonoscopy showed a circumferential tumour at the descending part of the colon. Biopsy of the lesion

showed adenocarcinoma of the colon. PET/CT scan showed a tumour at the descending part of the colon which is 18-FDG avid. In addition, there was an 8-cm tumour at section 4 and 8 of the liver abutting in the major hepatic vein and IVC which was also 18-FDG avid. In view of the impending large bowel obstruction, laparoscopic left hemicolectomy was performed using four operating ports. The operation time was 2 h and 44 min, and the blood loss was 50 mL. During laparoscopy, the surgeon assessed the liver metastasis that had involved about 25% of the total liver volume. The final pathology of the resected colon showed poorly differentiated mucinous adenocarcinoma with invasion to the serosa. Fourteen lymph nodes were examined and 5 showed tumour metastases.

As surgical treatment is technically not feasible for the liver metastasis, chemotherapy was commenced as an adjunct for the patient. In total 7 cycles of FOLFOX was administered, and the tumour was responding well to the chemotherapy. Reassessment CT scan showed that the tumour had reduced to 2 cm in size but in close proximity to the middle hepatic vein and the heart.

As patient preferred non-invasive management for the residual disease, HIFU was selected as an alternative ablative treatment for of the liver metastasis under general anesthesia. HIFU ablation was carried out using the JC HIFU system (Chongqing Haifu Technology, Chongqing, China). The ablation was performed using real-time ultrasound image guidance. The system comprised of a real time diagnostic imaging unit which provides direct visualization of the tumour, a therapeutic unit which consisted of a ultrasound energy transducer which can effectively converge the ultrasound energy at a 12-cm focal point, a degassed water circulation unit which provide a medium for ultrasound transmission outside the body and a computer system which integrated the above-named device

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unit. The focused ultrasound was produced by the transducer operation at 0.8 MHz. The target lesion was localized using a 3.6-MHz diagnostic ultrasound probe (Phillips), which is incorporated at the centre of the treatment transducer. Artificial right pleural effusion was induced before treatment in order to facilitate the transmission of ultrasound wave and prevent reflection from the lung parenchyma. Parallel slides of the target tumour with 5 mm separation including a 1-cm margin of the tumour were planned. In total 458,000 J of energy was transferred to the lesion with satisfactory grey scale change observed during the treatment which signified coagulation necrosis of the tumour lesion. The artificial right pleural effusion did not require drainage, and the patient was discharged on day 3 after HIFU therapy. Post-operative contrast CT scan showed complete ablation of the tumour lesion with no residual disease in the liver.

Modern management of colorectal cancer involved a multidisciplinary team in order to simplify treatment workflow on a complicated disease entity. In this patient, treatment was separated into laparoscopic colonic resection for the primary lesion which was going to cause bowel obstruction, effective chemotherapy which successfully downgraded the tumour to surgically manageable lesion and HIFU ablation to the residual tumour at a difficult position. Since the liver metastasis was near the hepatic vein origin and which was close to the heart, laparoscopic and percutaneous RFA would not be possible. Surgical resection provided one of the best oncological clearances but the price to pay would be a big surgical incision for a 2 cm tumour.

Among all type of minimally invasive therapy for liver tumour, HIFU is the only technique to be completely extracorporeal, through the use of nonionizing energy. As a non-invasive technique, HIFU is receiving increasing interest in the management of liver cancer. Originally, many a studies were only conducted in China, HIFU has been gaining its popularity across the world with its non-invasive nature. It achieves coagulation necrosis by means of thermal ablative effect where energy is built up in the tissue via the ultrasound propagation; the cavitation effect which causes rapid expansion of the particles along the

focused point of the ultrasound transmission; and last but not least it causes tumour vessel thrombosis for vessel smaller around 2 mm in size. It has been reported that HIFU can achieve complete tumour necrosis even when the lesion is located closely to the major hepatic vessel where high volume flow is anticipated. There will be less heat sink effect as compared to RFA as the thermal precipitation is from each focused ablation but not from heat conduction of an instrument. There is no irreversible damage to major vessels even though the adjacent tumour had been completely ablated. In this patient, complete liver tumour ablation was achieved with no surgical incision required and no complication was observed. In early studies, the complications of HIFU were mainly related to subcutaneous tissue injuries where the energy precipitated in the ultrasound beam pathway to the lesion. Clinical manifestations of subcutaneous injury include mild pain, skin oedema or even skin burn. Most of the complications were self limiting and did not require further intervention or treatment. Thermal injury to adjacent organ may occur as focused ultrasound heat may spread to surrounding area by diffusion. We had paid particular attention to the boarder of the heart as the targeted lesion was closely located. Ventilation control by the anaesthesiologist by halting respiratory movement had greatly reduced the undesirable movement of the diaphragm. Ultrasound beam might have passed through the beating heart during the procedure but as long as the focused point was staying away from the heart, no injury to the myocardium was observed.

HIFU is a totally non invasive ablative treatment modality. It produces mechanical destruction to the tumour by means of coagulation necrosis. It is a safe alternative treatment option for liver metastasis particular when the tumour is located in difficult location and when minimally invasive approach is desired.

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