

ORIGINAL ARTICLE

Intraoperative real-time tissue elastography during laparoscopic hepatectomy

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Abstract

Background: Real-time tissue elastography during open hepatectomy facilitates the differential diagnosis of liver tumors by providing information on elasticity. This study investigated the utility of intraoperative real-time tissue elastography (IORTE) during laparoscopic hepatectomy (LH).

Methods: Between 2012 and 2014, IORTE was performed during LH for 21 hepatocellular carcinomas (HCCs), 16 adenocarcinomas and 5 other tumors in 32 patients. The elasticity images were classified into six categories according to the modified criteria on the elasticity type of liver tumors, in which type 1 tumors show more strain than the surrounding liver and type 6 tumors no strain. The concordance of the IORTE findings with those of the pathological examination of the tumors was assessed (The registration no. 1418).

Results: Among the 21 HCCs, 20 were classified as “HCC pattern” (type 3, 4, or 5), resulting in a sensitivity of 95.2%, a specificity of 66.7% and an accuracy of 81.0%. Ten out of the 16 adenocarcinomas were classified as “adenocarcinoma pattern” (type 6), resulting in a sensitivity of 62.5%, a specificity of 92.3% and an accuracy of 81.0%.

Conclusion: IORTE is feasible and provides useful information on the elasticity of liver tumors in LH, in which conventional tumor palpation is difficult.

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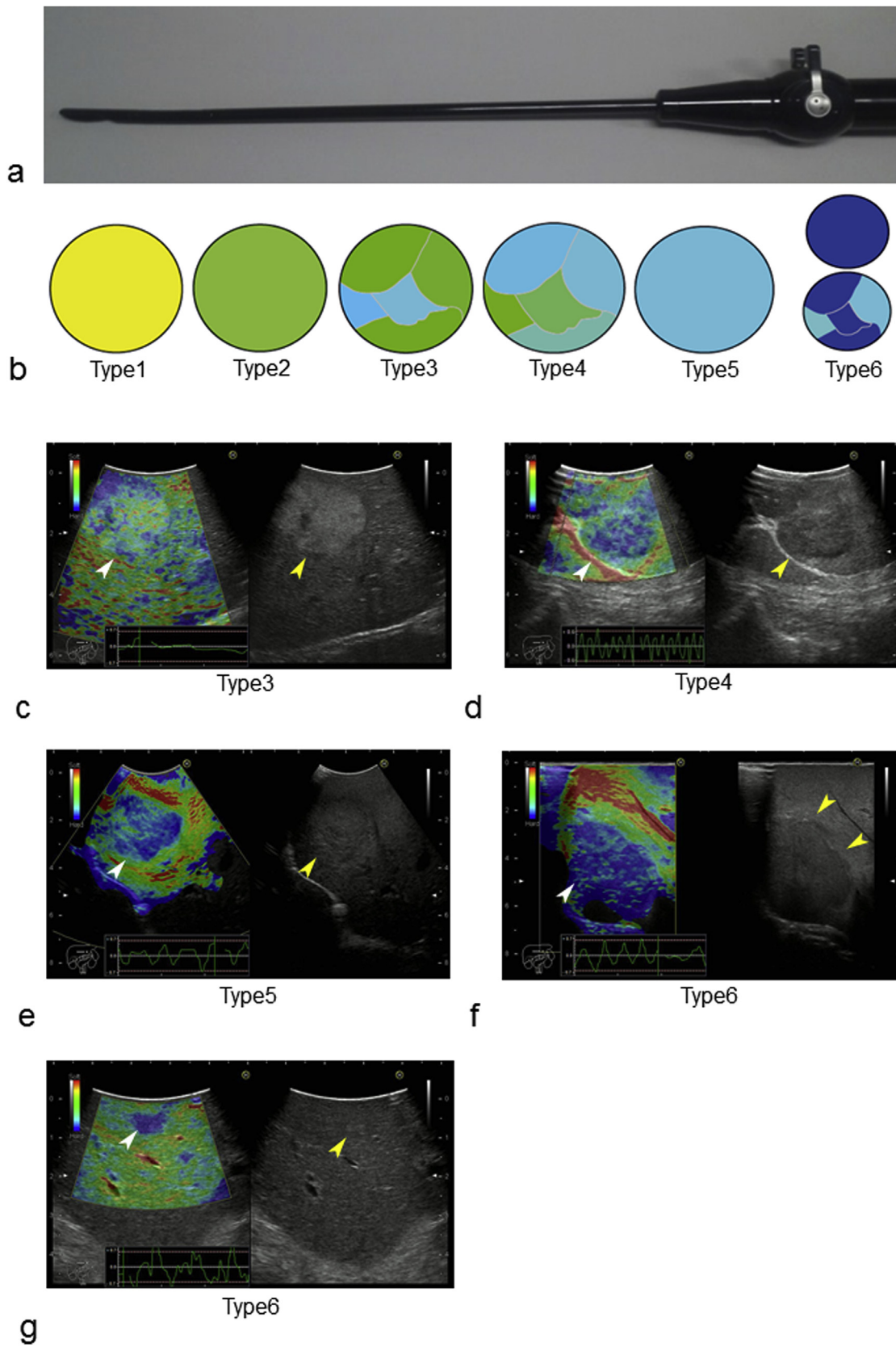
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Introduction

Since the introduction of laparoscopic hepatectomy (LH) in the 1990s, this less invasive approach has gradually gained broad acceptance because of the development of advanced surgical technique and devices.¹ Previous meta-analyses have demonstrated that LH is a safe procedure. Its advantages over open surgery with respect to bleeding and postoperative hospital in appropriately selected patients has been reported.^{2,3} However, the intraoperative examination of liver tumors is difficult in LH because conventional palpation is technically difficult, especially in the pure laparoscopic setting. Hata *et al.* reported that in 65 hepatectomies, 207 nodules of colorectal metastasis were newly found by classical palpation and/or inspection only.⁴

During liver surgery, accurate information on the location and characteristics of tumors scheduled for removal is required. Fundamental B-mode intraoperative ultrasonography (IOUS) is a useful tool for the diagnosis of liver tumors.^{5,6} Laparoscopic IOUS has a similar diagnostic performance in the detection of new lesions⁷ and has increased the safety of laparoscopic liver resection, by allowing real-time identification of portal veins and hepatic vessels. However, both the limited mobility of the probe due to the trocar's position and the inflexibility of the probe are among the technical problems that remain to be solved.⁸

Real-time tissue elastography provides visual information on tissue elasticity by estimating the strain modules based on the radio-frequency signals generated during external compression.^{9–11} Recent studies have demonstrated the utility of intra-



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