INTRODUCTION

Accurate tumor positioning in SBRT of liver lesions is of major importance, because high dose gradients are delivered in a few fractions. The use of electronic portal imaging (EPI) for verification is not sufficient, because lesion displacement can be independent of bony anatomy. Also Cone Beam CT (CBCT) does not help to visualize the lesions itself, since no iv contrast is used. Therefore, we implemented 3D ultrasound (3DUS) as IGRT tool in SBRT of liver lesions. Our previous results demonstrated that liver deformation and blurring of the US scan as a result of breathing motion, influenced the hampered our image segmentation. As a result we studied the additional value of Active Breathing Control (ABC) during 3D US.

The aim of this study is to establish the use of 3D ultrasound (US) combined with Active Breathing Control (ABC) for IGRT in liver lesions.

RESULTS

In this study we demonstrated that the combination of US scanning and ABC optimized our image quality and resulted in a smaller inter- and intra-observer-variation of image segmentation. The inter-observer variation, defined as the mean SD of respectively the FB and BH US scans, in the 2 patients was reduced in left/right from 1.7 mm to 1.0 mm, in ant/post from 3.0 mm to 1.8 mm and in sup/inf from 4.9 mm to 2.6 mm with a mean reduction of 42% (p<0.01). The intra-observer variation changed in left/right from 0.7 mm to 0.2 mm, in ant/post from 1.6 mm to 0.2 mm and sup/inf from 1.7 to 0.8 mm with a mean reduction of 66% (p<0.01).

We demonstrated a significant difference between US and EPI image guidance. The mean 3D table shifts in 58 treatment fractions in FB consisted of 3.6 mm in left/right [1.0 to 8.9 mm], 2.6 mm in ant/post. [1.9 to 10.5 mm] and 5.4 mm in sup./inf. direction [0.4 to 15.1 mm].

CONCLUSIONS

3DUS imaging for image guidance in SBRT of liver lesions is an accurate and feasible method, although its accuracy is often hampered by breathing motion. Therefore, ABC-based breath-hold in mid-ventilation during 3DUS imaging represents an important advancement in 3DUS IGRT, since it can significantly reduce the intra- and inter-observer variability in 3DUS-based 3D table shift correction.