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Liver Stiffness is Subject to Postural Changes

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Extended Abstract

Liver stiffness has emerged as a non-invasive biomarker to assess the severity of liver fibrosis. Recommended by major clinical guidelines [1-3], transient elastography (TE) is a clinically available method to measure liver stiffness. This study aimed to investigate the effect of body posture on liver stiffness measurements, using a newly developed palm-sized wireless TE system with real-time B-mode imaging guidance (named as Liverscan). Traditionally, liver stiffness is measured in the supine position, but we sought to explore the feasibility of alternative body positions for easier mass screening and home use. A cohort of 30 patients with chronic liver diseases was scanned using Liverscan in three different postures: supine, seated, and standing, with the right arm extended. Attempts were made to collect 10 valid measurements for each posture. The median value was calculated to represent the Young's modulus of the liver in the corresponding posture condition. Because Fibroscan is considered the best-validated TE system in the hepatology field [4], each patient underwent the contemporary Fibroscan examination performed in the supine position for comparison.

To ensure consistency in the measurement of the liver parenchyma across postures, several control measures were employed. Real-time monitoring of respiratory phases was done using a wearable pressure sensor. Liver stiffness measurements were standardized in the end-inspiratory phase. A measurement site on the skin surface was marked, at which the anatomic landmarks visualized in B-mode images were used as references for consistent measurements in the same cut-plane of the liver.

Statistical analysis was performed to compare liver stiffness measurements among the supine, seated, and standing postures using a one-way repeated measures ANOVA. Post-hoc pairwise comparisons and Pearson correlation coefficients were calculated to identify significant differences and correlations between Fibroscan and Liverscan measurements in the different postures.

The results showed that liver stiffness varied significantly among the three postures ($P = 0.0025$). The higher stiffness values were observed in the standing (5.6 ± 1.2 kPa) and seated positions (5.6 ± 1.1 kPa), compared with that in the supine positions (4.7 ± 0.7 kPa). However, there was no significant difference in stiffness between the seated and standing positions ($P = 0.934$). Moreover, body posture increased the variability of liver stiffness measurements, as assessed by the IQR/median (supine: 19 ± 4%, seated: 27 ± 12%, standing: 27 ± 11%). There was a strong correlation between Fibroscan and Liverscan measurements in the supine position ($r = 0.60$, $P < 0.001$), while the correlations of Fibroscan with the two non-lying positions were poor.

In conclusion, this study demonstrated that liver stiffness is posture-dependent. Transitioning from the supine position to an upright posture, either seated or standing, caused liver stiffening. We speculated that the compression of liver tissue caused by gravity during upright postures may contribute to an increase in liver stiffness. The feasibility of performing liver stiffness measurements in non-lying positions offers greater convenience and operational efficiency. However, we proved that liver stiffness measurement is conditional in nature. As one of the influencing factors, these findings suggest that body posture should be taken into consideration when interpreting liver stiffness results in clinical practice. Future research is needed to explore additional factors that may influence liver stiffness measurements in real-world settings.

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