

A reliable M-mode ultrasound protocol for the assessment of diaphragm motion

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Introduction

- Diaphragm is the principal inspiratory muscle
- Different techniques have been used to assess diaphragm motion. Among them, M-mode ultrasound has gain particular interest since it is non-invasive and accessible.
- However it is operator-dependent and no objective acquisition protocol has been established.

[PURPOSE] to establish a reliable method for the assessment of the diaphragmatic motion via the M-mode ultrasound.

Material and Methods

- 51 healthy subjects

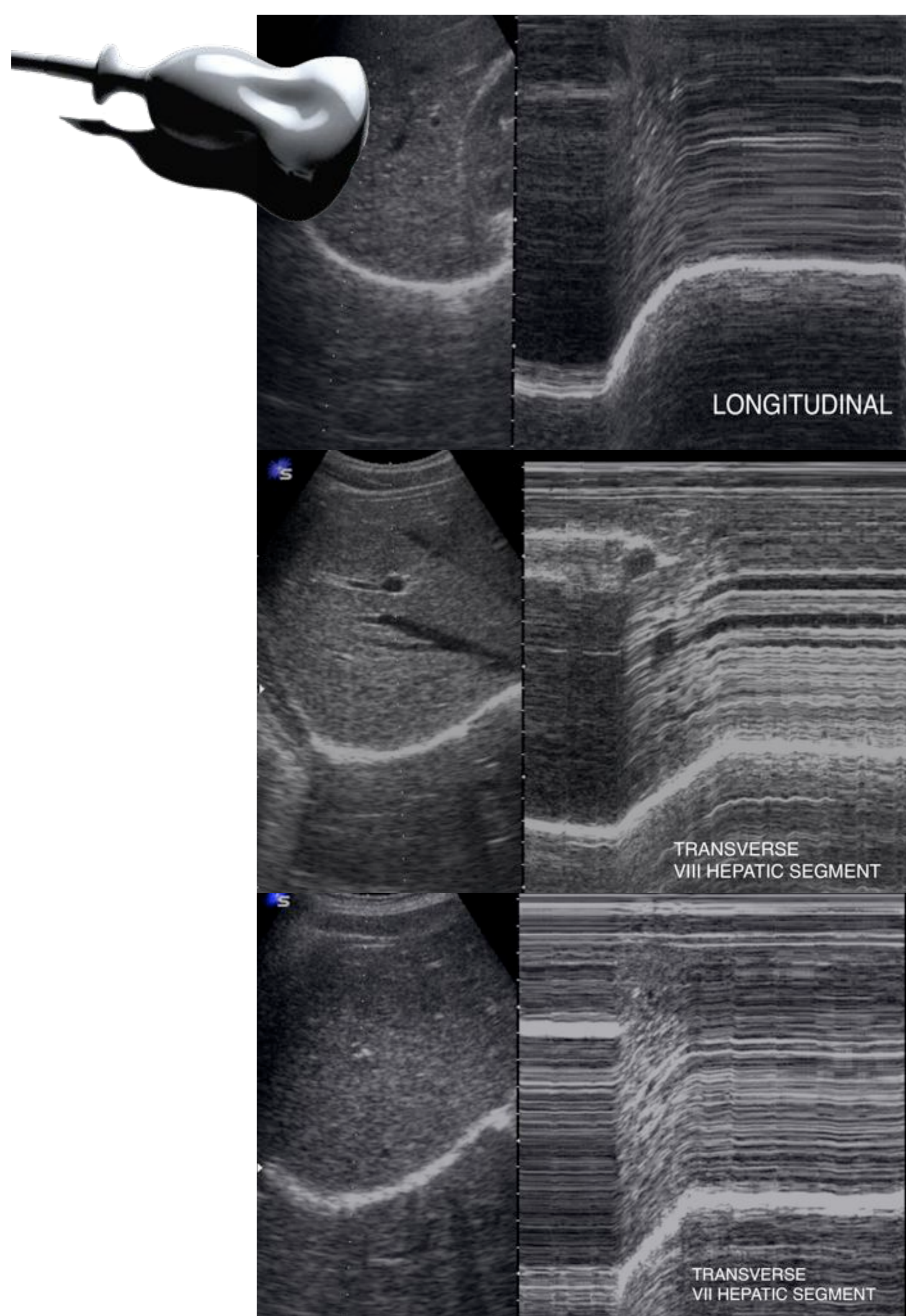


41 subjects
58±8.5 Kg
165±6.6 cm
21±3.3 Kg/cm²

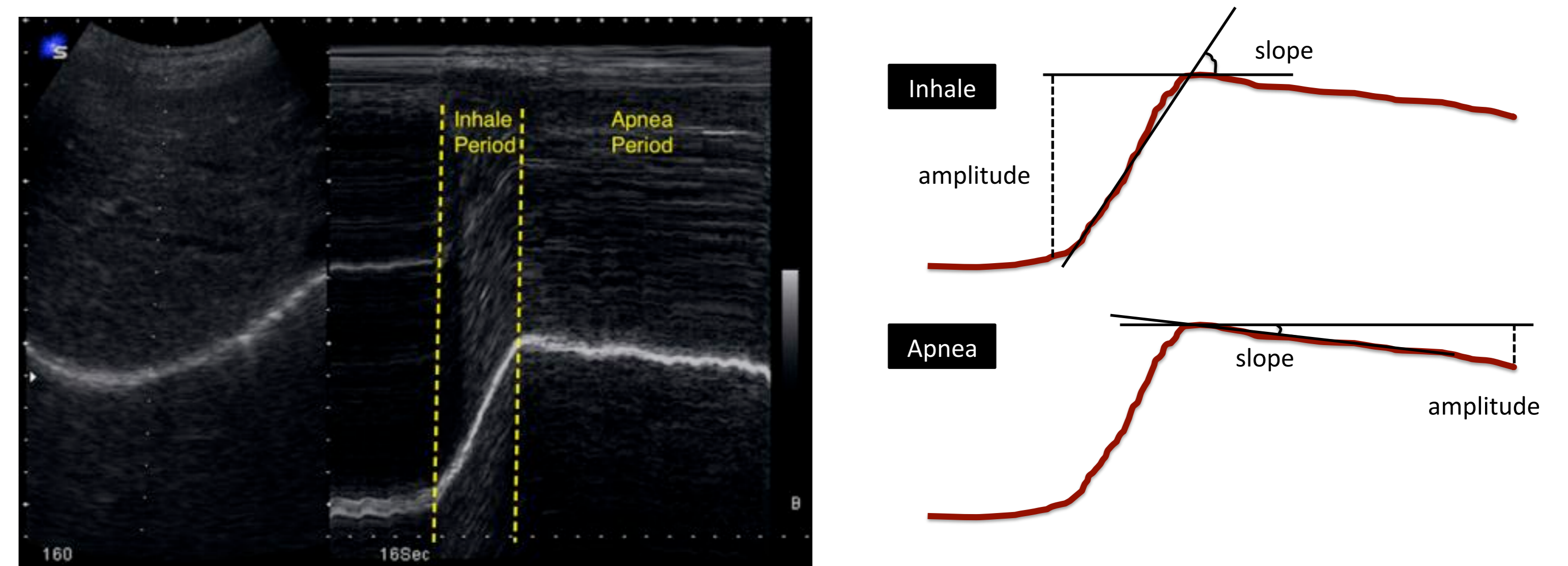


10 subjects
75±11.6 Kg
179±7.7 cm
23.4±3.4 Kg/cm²

- The right diaphragmatic motion was measured by M-mode ultrasound imaging in three different transducer positions:



- Four US features of the diaphragm range of motion were extracted before and after the diaphragmatic breathing technique (DBT) implementation, for each transducer positioning:



Results

Right Diaphragmatic Range of Motion Results

	DBT	Transverse VIII Hepatic Seg.	Transverse VII Hepatic Seg.	Longitudinal
Inhale				
Amplitude (mm)	Before	55.3 ± 13.4	52.3±15.2	52.5±15.1
	After	63.8 ± 13.2	54.9±15.7	61.1±15.2
Slope (°)	Before	50.31 ±8.1	48.7±9.06	50.5±9.0
	After	53.8 ± 9.17	50.5±10.2	52.9±9.9
Apnea				
Amplitude (mm)	Before	7.9±5.8	7.7±5.6	5.3±3.8
	After	6.8±5.8	7.2±5.4	7.4±6.0
Slope (°)	Before	6.5±11.43	4.9±3.7	3.6±2.7
	After	4.1±3.11	4.6±3.7	5.0±4.4

- DBT and transducer positioning affect the measurement of the diaphragm (ANOVA, $p < 0.05$).
- The measurements from the transverse axis with a more middle ROI reveal a strong correlation ($R=0.52$, $p < 0.05$) with statistical differences ($p < 0.05$).
- The diaphragmatic range of motion increased 8.4 mm after DBT with a shift in the line slope from 0.05 to 0.39 (after).

Conclusions

- The assessment of the diaphragm via M mode ultrasound is substantially dependent on the positioning of the transducer.

[CLINICAL IMPLICATIONS] Transverse transducer positioning with the image line crossing the right portal vein at the VIII Hepatic Segment is the most reliable and consistent way to study diaphragm motion

References

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