In Vitro Comparison of Ultrasound Based Elastography Techniques

Stéphanie Franchi-Abella[*1] MD, Caroline Elie[**] MD-PhD, Jean-Michel Correas[1] MD-PhD**

*Paediatric Radiology Department, Hôpital Bicêtre, Le Kremlin-Bicêtre, France
**Adult radiology Department, Hôpital Necker, Paris France
1: Institut Langevin, Université Paris VII – Paris, France.

QIBA Phantom Study 2012

Goal of this study

- Evaluation of different elastography methods on a calibrated elastography phantom
  - Accuracy of qualitative, semi-quantitative and ***quantitative evaluations***
  - Artefacts

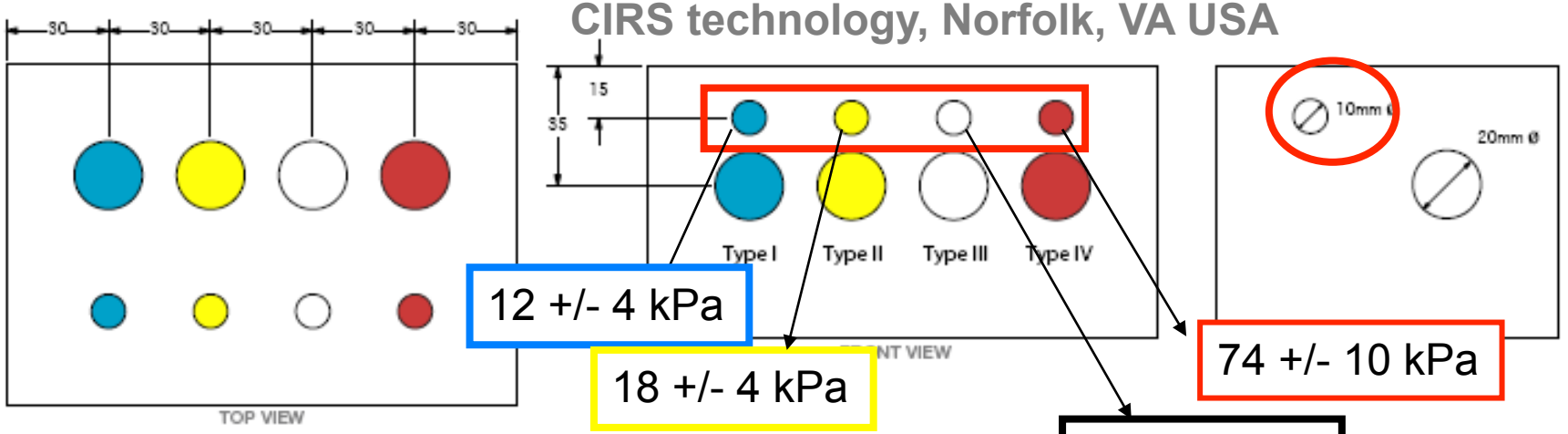
- In order to improve the clinical comprehension and use of elastography

Material and Methods

Model 049

MODEL 049 ELASTICITY QA PHANTOM - SPHERICAL

CIRS technology, Norfolk, VA USA



Material and Methods

Model 049

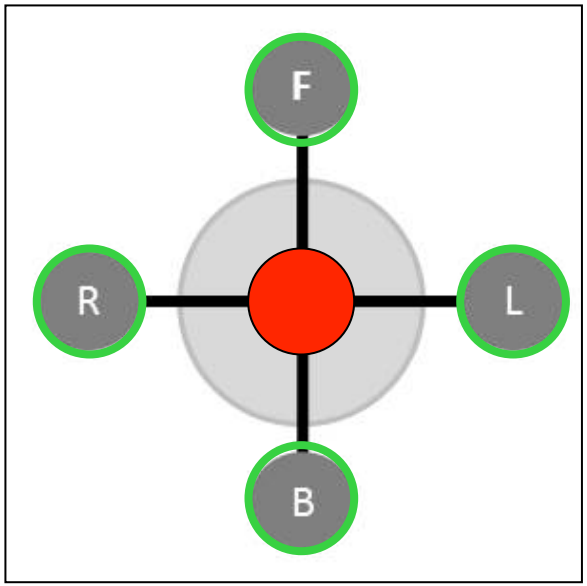
- One operator
- 2 US diagnostic imaging manufacturers (High Frequency Linear Probes)

- SW Elastography: 3 methods (H to J)
  - Absolute elasticity value in kPa or in m/s
  - Elasticity values converted from m/s to kPa

- Each inclusion
  - 2 orthogonal planes
  - 10 measurements

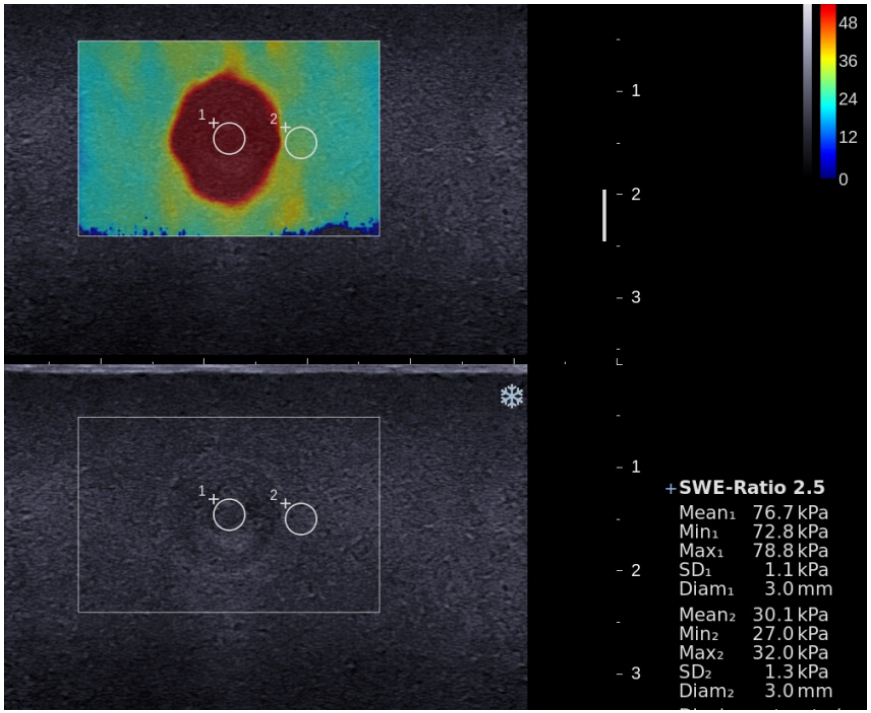
ROI :

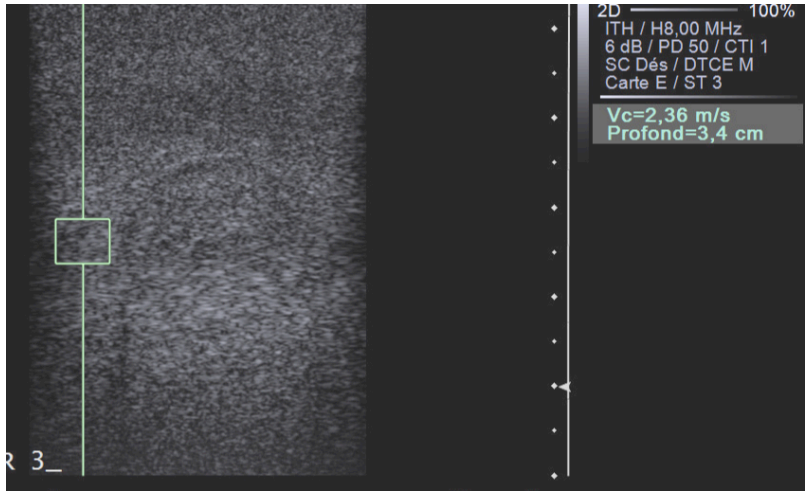
Inclusion
Above (F)
Beneath (B)
Right side (R)
Left side (L)

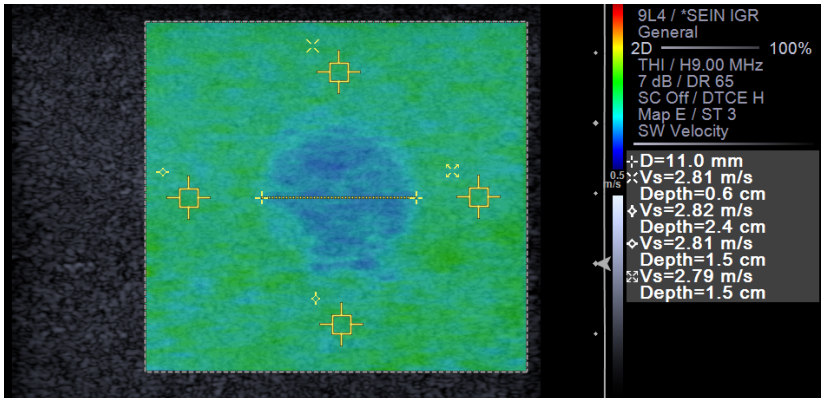


- **Statistical analysis:**
  - Classified as in or out of the theoretical interval
  - Relative difference between observed values and expected ones *(observed value- mean theoretical value)/ mean theoretical value. % and bias*
  - Comparison with two position of the probe, position of the ROI when measuring BG

Material and Methods

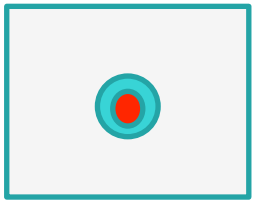






Results and discussion

Quantitative evaluation



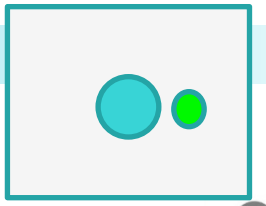
Inclusion

stiffness

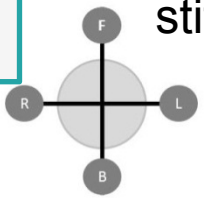
Methods	Inclusion 1		Inclusion 2		Inclusion 3		inclusion4	
	12 kPa (8-16kPa)		18 kPa (14-22kPa)		47 kPa (41 – 53 kPa)		74 kPa (64 -84 kPa)	
	in theor. range	Relative difference (%)	in theor. range	Relative difference	in theor. range	Relative difference	in theor. range	Relative difference
		Bias (kPa)		Bias (kPa)		Bias (kPa)		Bias (kPa)
H	0%	+35,2 ± 1,6	0%	-30,3 ± 5,3	0%	-39 ± 2,44	60%	10 ± 8,2
		-4,1 **± 0,2**		-6,27 **± 0,62**		-18,7 **± 0,77**		7,1 **± 6,1**
I	0 %	-37,7 ± 1,1	19%	-23,3 ± 0,9	100%	-1,4 ± 2,6	100%	1,3 ± 2,5
		-3,8 **± 0,09**		-4,15 **± 0,13**		-0,46 **± 1,22**		0,54 **± 1,81**
J	28,5%	-25,88 ± 10,96	0%	-32,73 ± 3,48	12,5%	-24,68 ± 6,18	70%	-10,56 ± 9
		-3,1 **± 0,97**		-5,89 **± 0,42**		-11,61 **± 2,19**		7,83 **± 5**

Results and discussion

Quantitative evaluation



Background stiffness



Methods	BG F		BG B		BG R		BG L	
	30 kPa (25-35 kPa)		30 kPa (25-35 kPa)		30 kPa (25-35 kPa)		30 kPa (25-35 kPa)	
	in theor. range	Relative difference (%) Bias (kPa)	in theor. range	Relative difference Bias (kPa)	in theor. range	Relative difference Bias (kPa)	in theor. range	Relative difference Bias (kPa)
H	0%	+31,6	Na	Na Na	0%	-38,2 ±	60%	35,5
I	31,6%	-27 ± 3,17 -10,1 ± **1,22**	52,6%	-19 ± 2,55 -6,1 ± **0,56**	100%	-8 ± 5,28 -2,4 **± 1,2**	100%	-7 ± 1,58 - 2,1 **± 0,62**
J	8,7%	-22,1 ± 3,6 -6,62 ± **0,84**	2,8%	-29,44 ± 7,6 -8,82 **± 1,6**	0%	-38,6 ± 4,75 -11,58 **± 0,87**	70%	-37,94 ± 8,35 -11,37 **± 1,55**

QIBA discussion (Claude Cohen-bacrie)

- What is actually assessed with these measurements?
  - Point spread function? Bias? Resolution?
- What is the impact of the psf on the absolute measurement assessment in these inhomogeneous phantoms?
- Should we distinguish experiments for resolution and bias assessment?

Conclusion

- Variable performance according to the method
- Bias in the measurements vary with systems: calibration according to the application
- Quantitative evaluation of stiffness using SWE = bias for soft targets. Measures could be precise if bias is taken into account