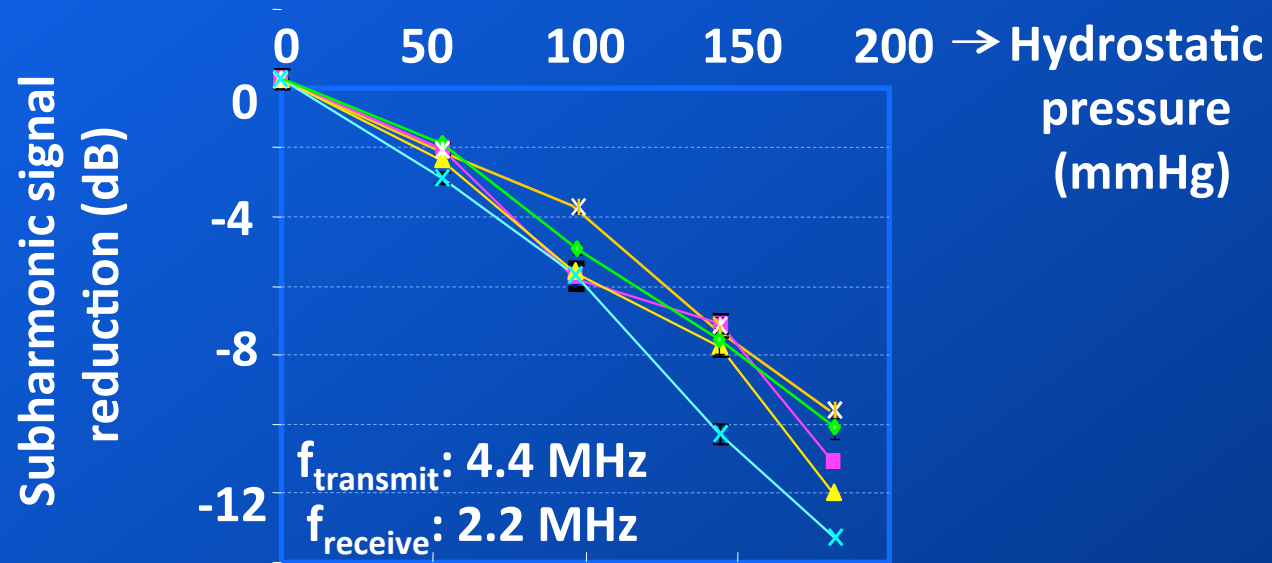


Subharmonic Aided Pressure Estimation (SHAPE)



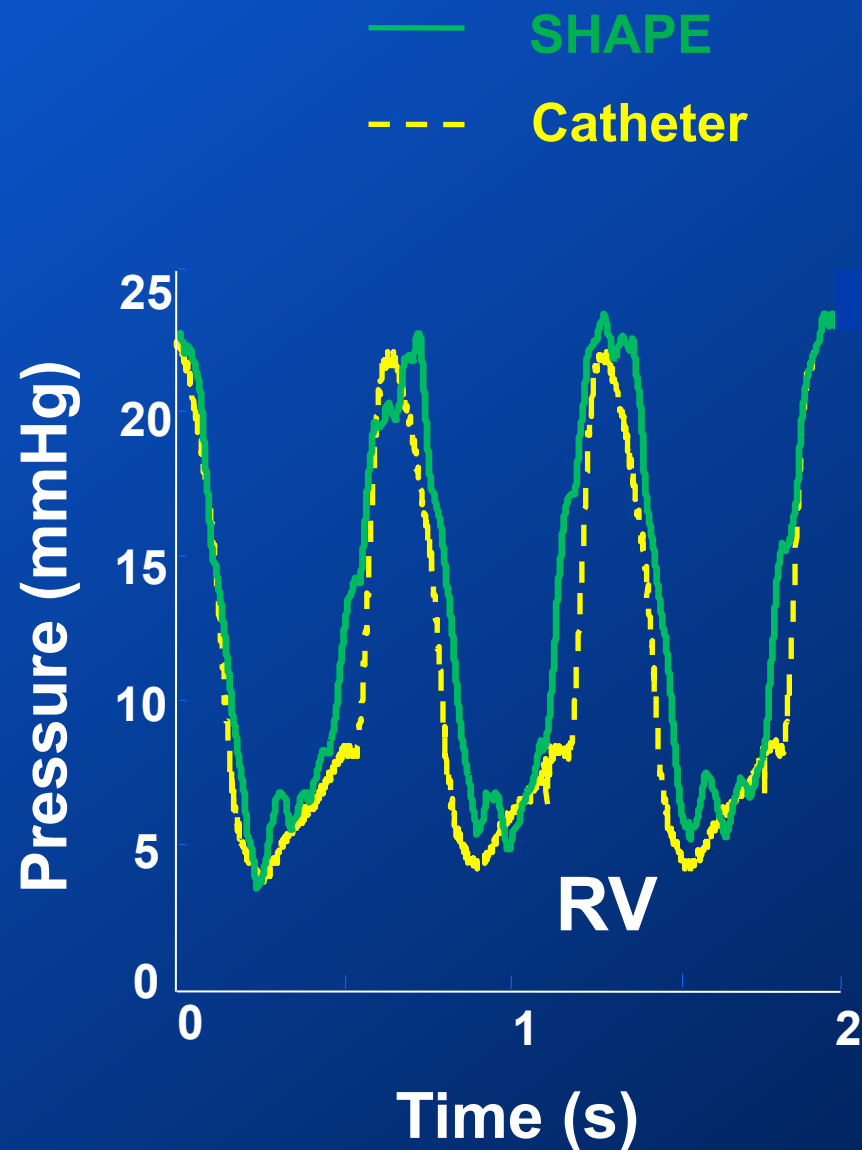
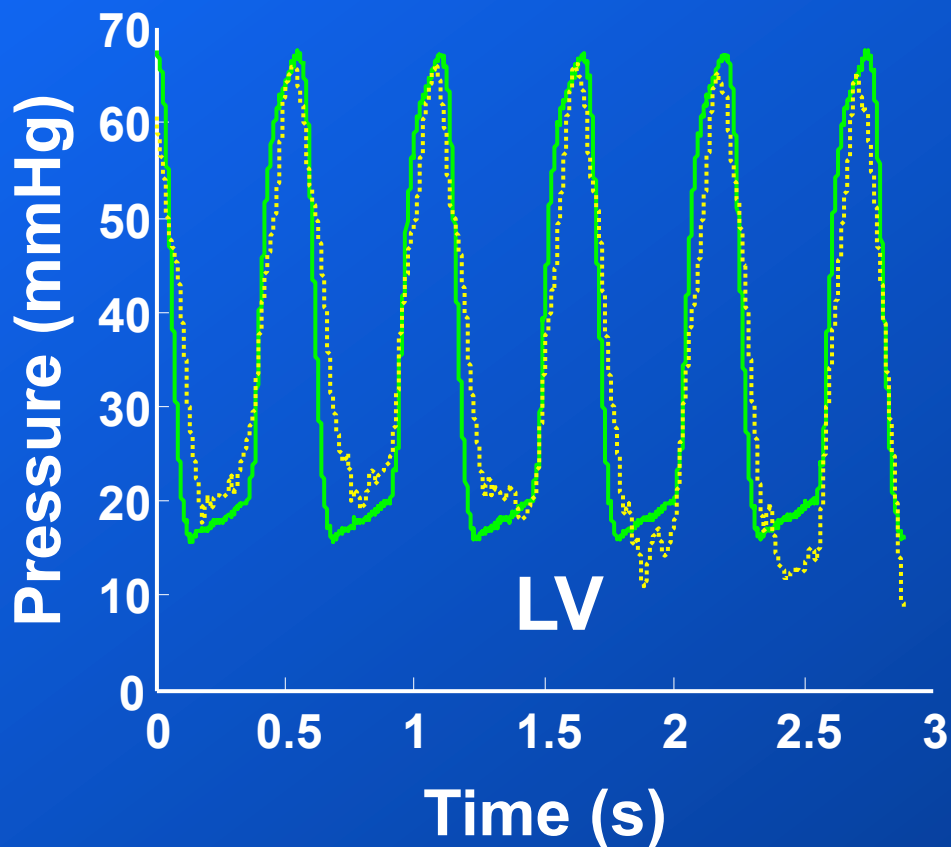
[Halldórsdóttir et al.,
Ultrason Imaging, 2011]

Subharmonic reduction over
0 to 186 mmHg (dB)

Linear
regression
(r^2)

Sonazoid™	13.3 ± 0.2	0.99
ZFX	12.2 ± 0.2	0.97
Definity®	11.0 ± 0.3	0.98
Optison™	10.1 ± 0.2	0.97
Levovist®	9.6 ± 0.2	0.98

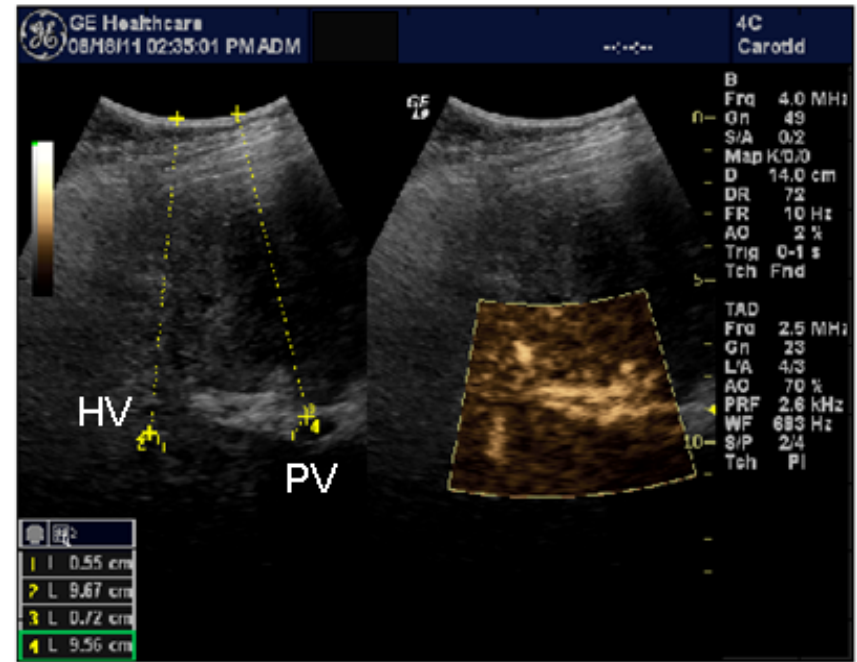
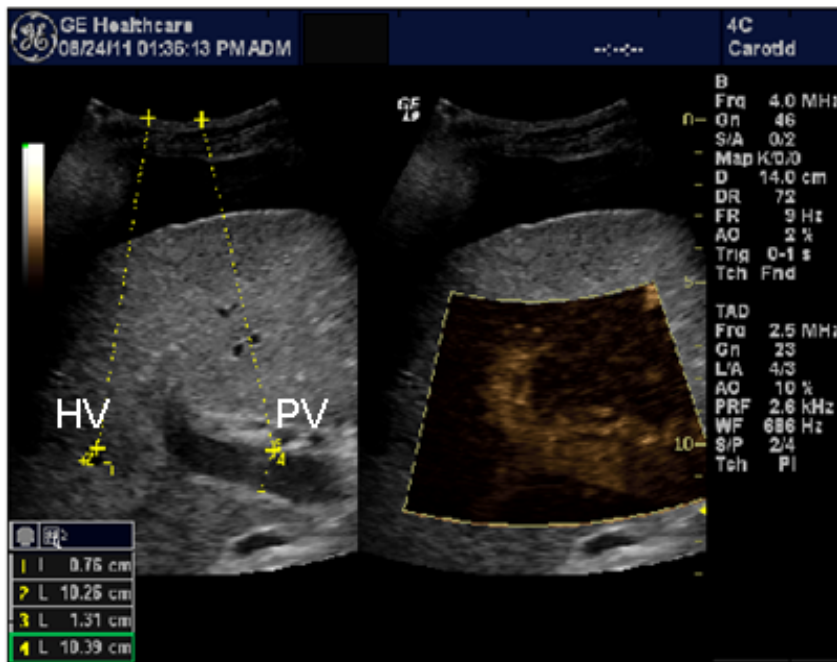
Cardiac Pressure Waveforms



RV Pressures with Individual Calibration Factor

Canine		SHAPE (mmHg)	Catheter (mmHg)	Error (mmHg)
1	Peak Systolic	24.5	22.2	-2.3
	Minimum Systolic	5.4	4.5	-0.9
2	Peak Systolic	21.3	21.3	0.0
	Minimum Systolic	5.0	4.2	-0.8
3	Peak Systolic	23.6	20.2	-3.4
	Minimum Systolic	5.3	5.0	-0.3
4	Peak Systolic	21.2	18.1	-3.1
	Minimum Systolic	3.6	3.5	-0.1
5	Peak Systolic	32.8	30.2	-2.6
	Minimum Systolic	8.2	6.4	-1.8

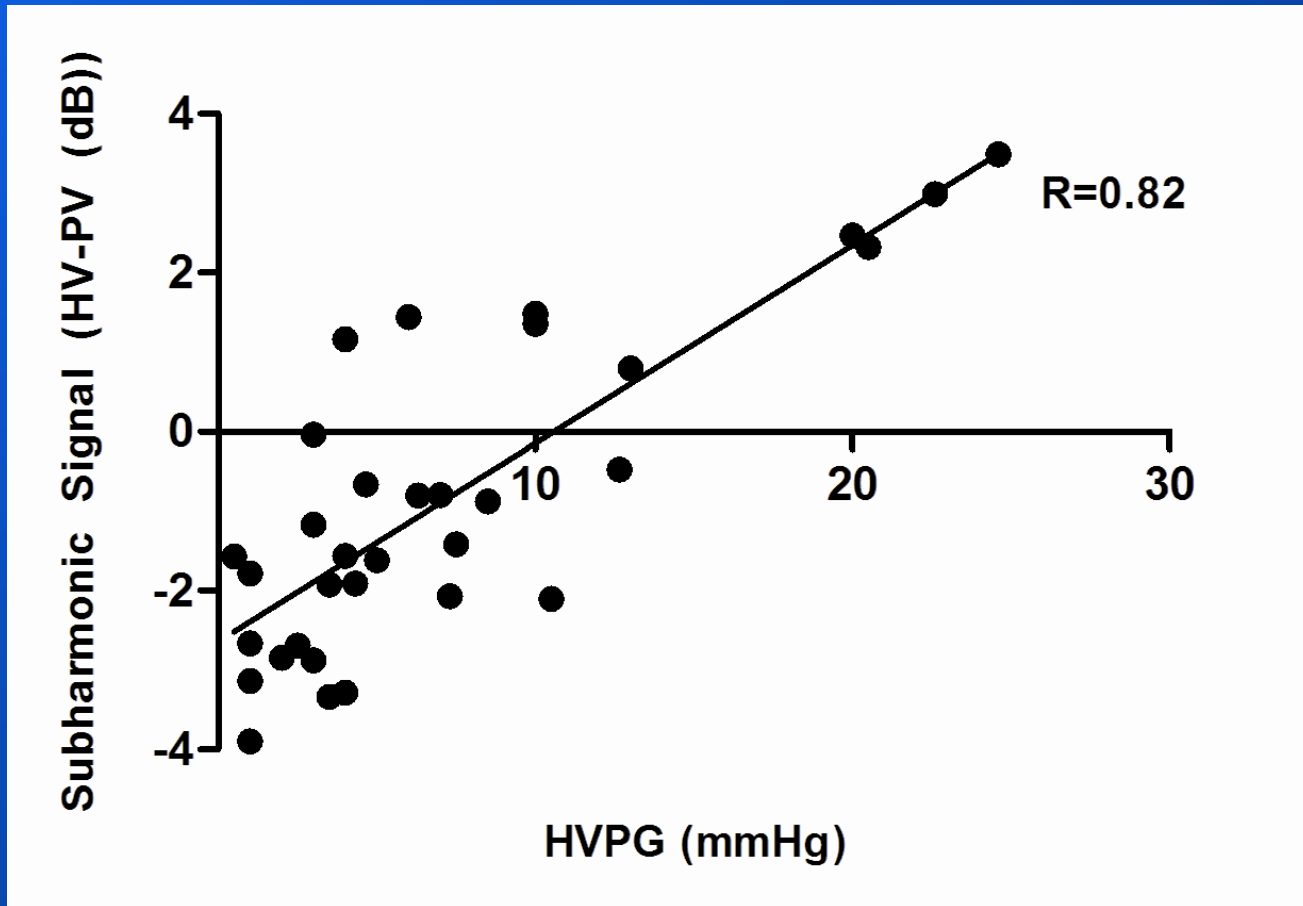
SHAPE as a Screening Tool for Portal Hypertension



SHAPE acquisitions in two patients (obtained at their respective optimal acoustic outputs). Left: A patient insonated at an acoustic output of 10% with HVPG = 5 mmHg

Right: A patient insonated at an acoustic output of 70% with HVPG = 23 mmHg

Subharmonic Signal versus HVPG



Motivation for Cardiac Pressure Estimation

- There are about 83.6 million Americans suffering from more than one type of cardiovascular disease with 77.9 million Americans having high blood pressure and 15.4 million Americans having coronary heart diseases
- Monitor effects of different treatment regimens
- Identify biopsy-negative transplant rejections
- Cardiac transplantation work-up
- Identify efficacy of cardiac resynchronization therapy
- Approximately 500,000 new cases of heart failure diagnosed each year in the United States and ten times that number of Americans is currently affected by heart failure

Motivation for Estimating Portal Hypertension

NASH affects 2-5% of Americans resulting in about 5.5 million people with cirrhosis

Cirrhosis without portal hypertension has a small effect on mortality. However, it is the manifestations of portal hypertension, which predict survival

Approximately 25,000 Americans die each year from chronic liver disease and cirrhosis and more than 300,000 people are hospitalized

LV Pressures with Individual Calibration Factor

LV Pressures	Canine 1			Canine 2		
	SHAPE	Catheter	Error	SHAPE	Catheter	Error
	(mmHg)	(mmHg)	(mmHg)	(mmHg)	(mmHg)	(mmHg)
Mean Diastolic	20.1	17.6	2.5	14.2	13.4	0.8
Min. Diastolic	15.9	15.7	0.2	7.5	8.9	-1.4
End Diastolic	22.1	19.7	2.3	19.1	16.9	2.2
Peak Systolic	70.2	68.8	1.4	83.8	82.1	1.7
Heart Rate	109.8	109.9		105.5	109.9	