The Role of Advanced Image Guidance in Liver Surgery

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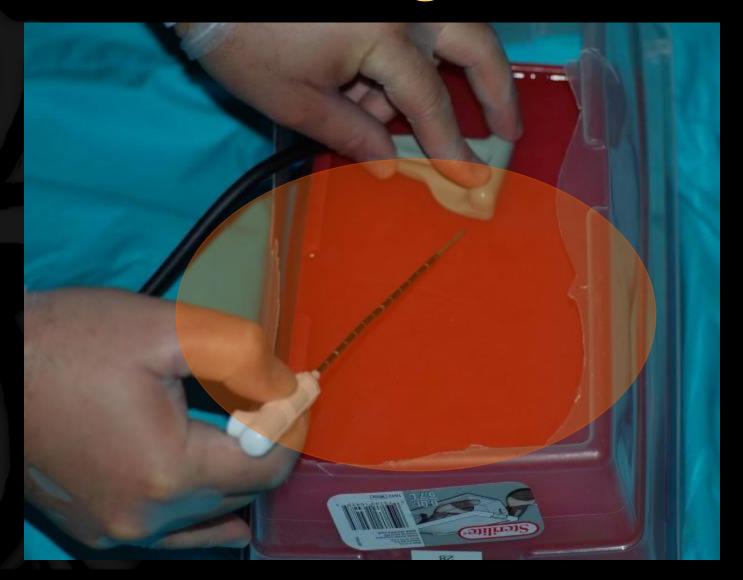


Uncompromising Excellence. Commitment to Care.

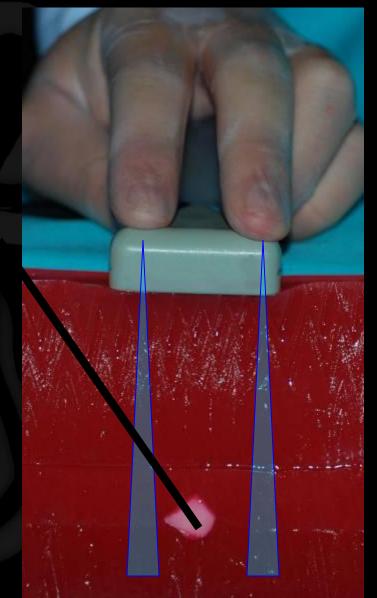
Background

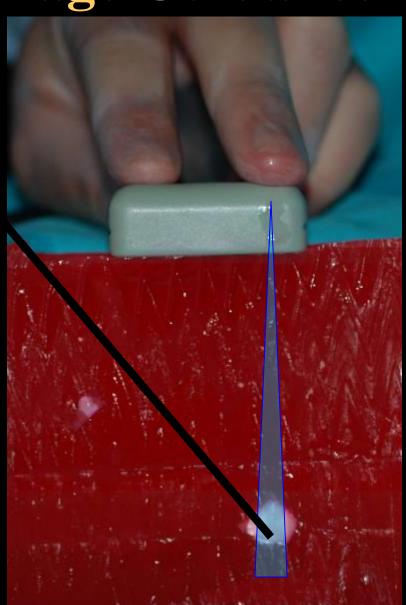
- Ultrasound is a routine part of hepatic surgery
 - Identification of tumors
 - Define intraparenchymal vascularity
 - Targeting for biopsy, ablation, others...
- Ultrasound is 2D (real time)
- Advancements in imaging / image guidance
 - Cross sectional
 - US

Traditional Image Guidance



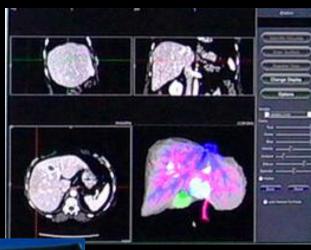
Traditional Image Guidance





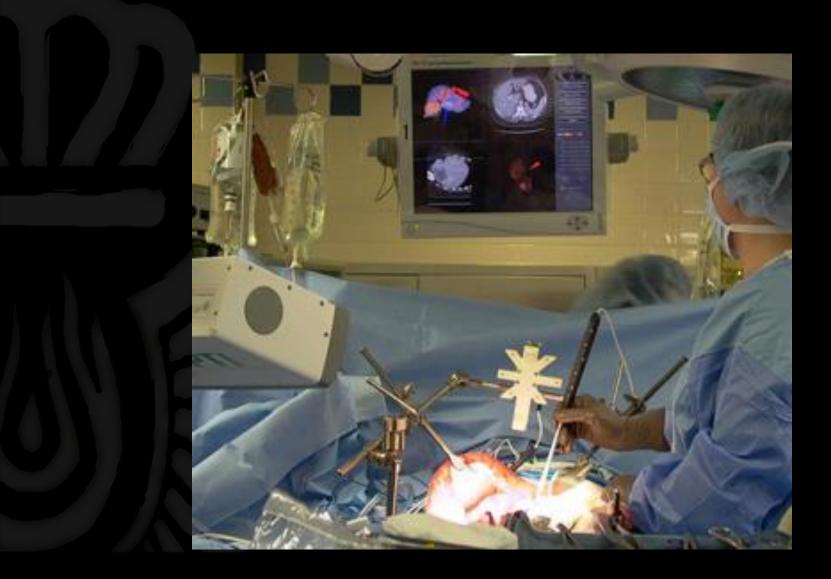
Advanced Image Guidance CT







Advanced Image Guidance CT



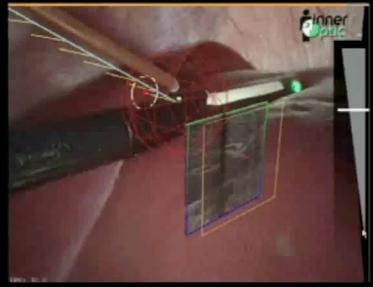
Advanced Image Guidance CT with US registration



Advanced Image Guidance US

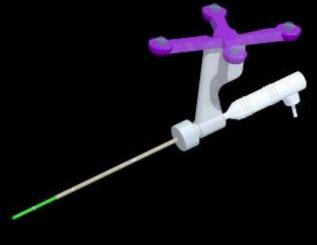






Early Targeting Reflectors







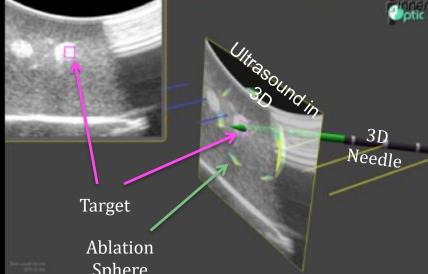


Early Version

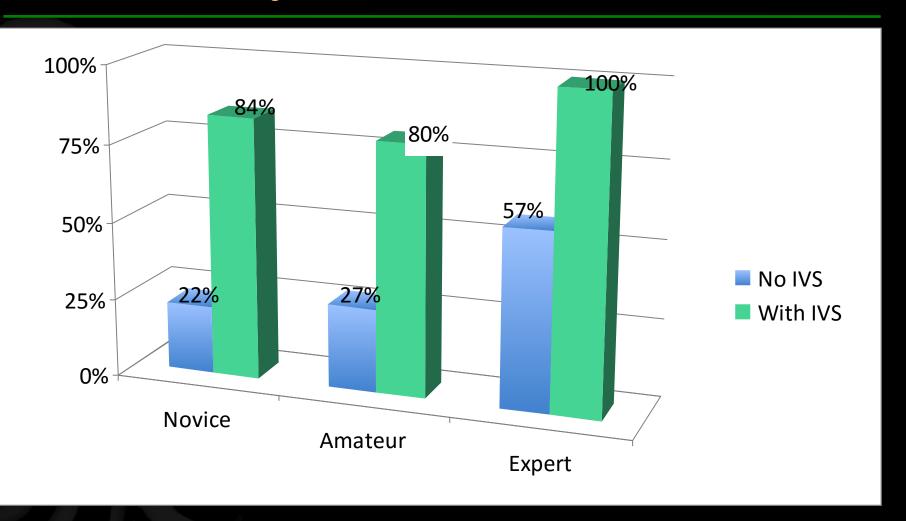






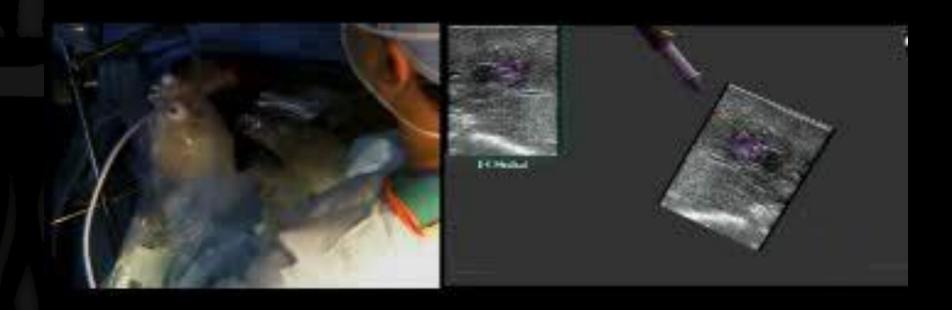


Study Results - Overall



Accuracy = % of Tumors Hit P < 0.0001 N=60 per user 5mm Target

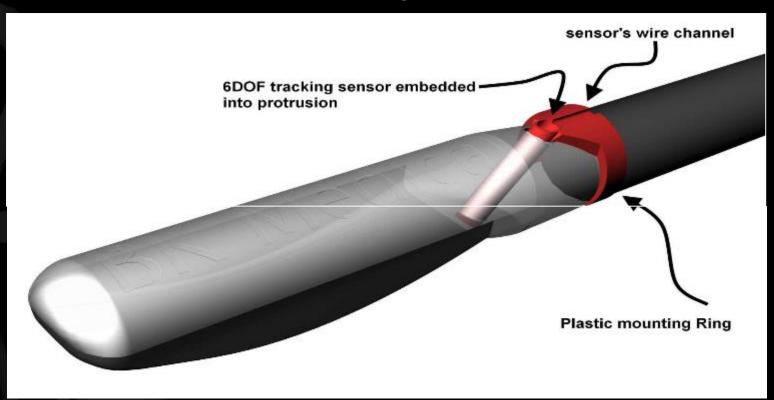
First Clinical AIG Case



EMF System



EMF System



EMF System





Results of the Phase I laparoscopic quantitative targeting study.

Target "Hit" Rates	No Guidance	With Guidance
Novices	4.5%	100%
Experts	59%	100%

AIG with RFF





AIG with RFF



AIG with RFF

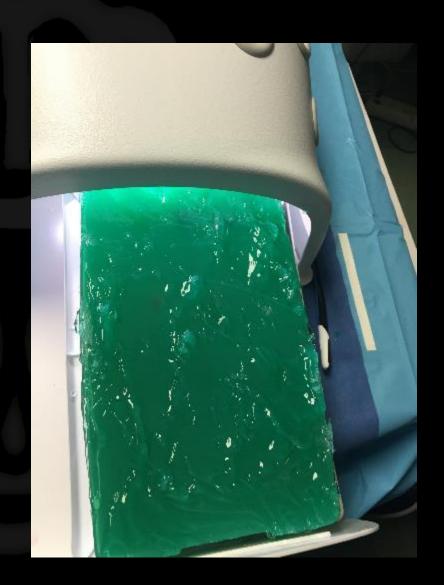
Precommercialization Study

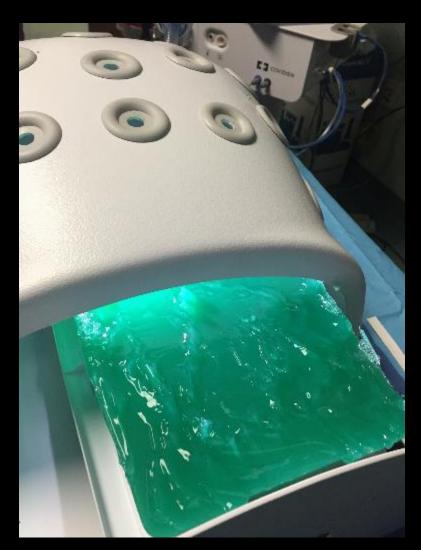
- 3 groups
 - Novices no formal surgical/medical training
 - Intermediates surgical residents
 - Experts HPB-Surgeons
- Each participant was asked to identify phantoms by US guidance
- Phantom targeting was then randomized
 - US guidance alone (USG, n=10)
 - 3-D image guidance using the Emprint[™] SX device (3DG, n=10)

MW Ablation Platform and configuration



Targeting Configuration

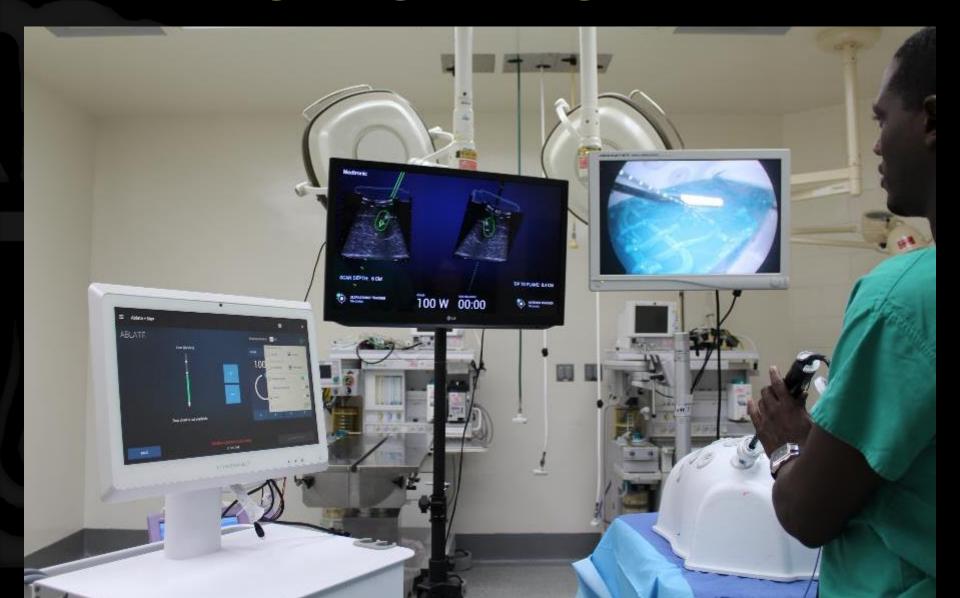




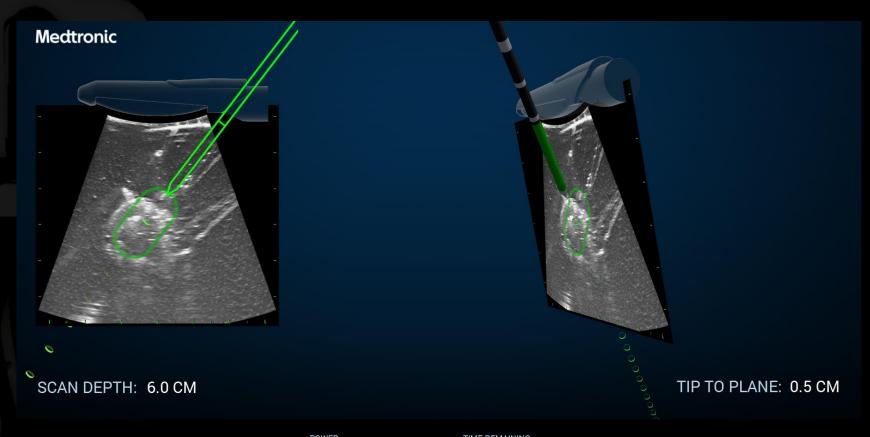
Targeting Configuration



Targeting Configuration



Microwave Ablation Platform & Configuration





100 W 00:00



Results

	Sonographic targeting	3-D Guided targeting	p – value
Mean time to identify target (sec.)	31.8	34.1	0.7168
Mean time to needle position (sec.)	129.2	18.3	0.0000
Number of hits/Total targets	26/40	40/40	0.0000
Number of misses	206	7	0.0000

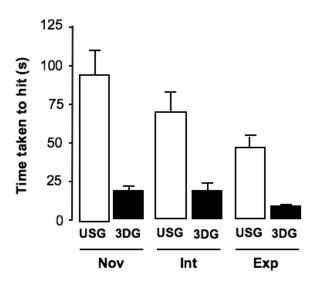
Table 2: Unguided targeting versus 3-D guided targeting in intermediates.

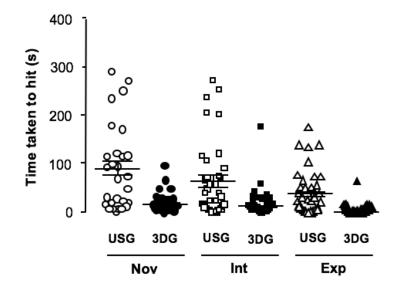
Sonographic targeting	3-D Guided targeting	p – value
22.3	23.1	0.8457
102.1	18.6	0.0002
37/40	40/40	0.0832
149	10	0.0000
	22.3 102.1 37/40	22.3 23.1 102.1 18.6 37/40 40/40

Table 3: Unguided targeting versus 3-D guided targeting in experts.

	Sonographic targeting	3-D Guided targeting	p – value
Mean time to identify target (sec.)	14.8	12.8	0.3136
Mean time to needle position (sec.)	59.2	8.1	0.0000
Number of hits/Total targets	36/40	40/40	0.0440
Number of misses	128	1	0.0000

Results





Conclusions

• More accurate – less complications?

Improvement of surgical outcomes

- Application to other procedures:
 - Vascular access
 - Biopsy
 - Bile duct cannulation

Advanced Image Guidance for Liver Ablation

Advanced Image Guidance for Liver Resection ??!!

AIG Prototype

AIG Prototype



AIG Liver Resections (ex-vivo)

AIG Liver Resections (in-vivo)

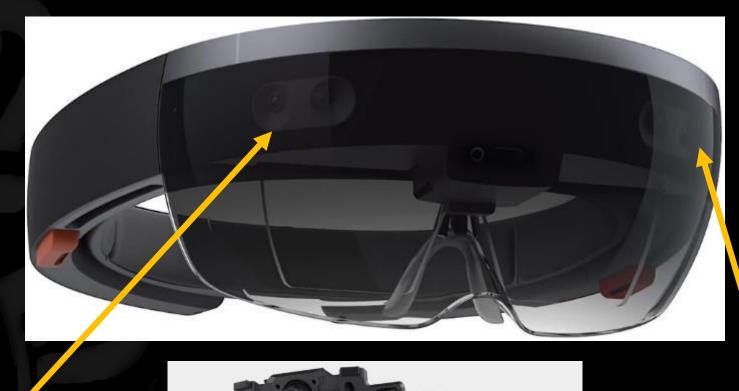
Holographic Enhanced MWA

Holographic Technology



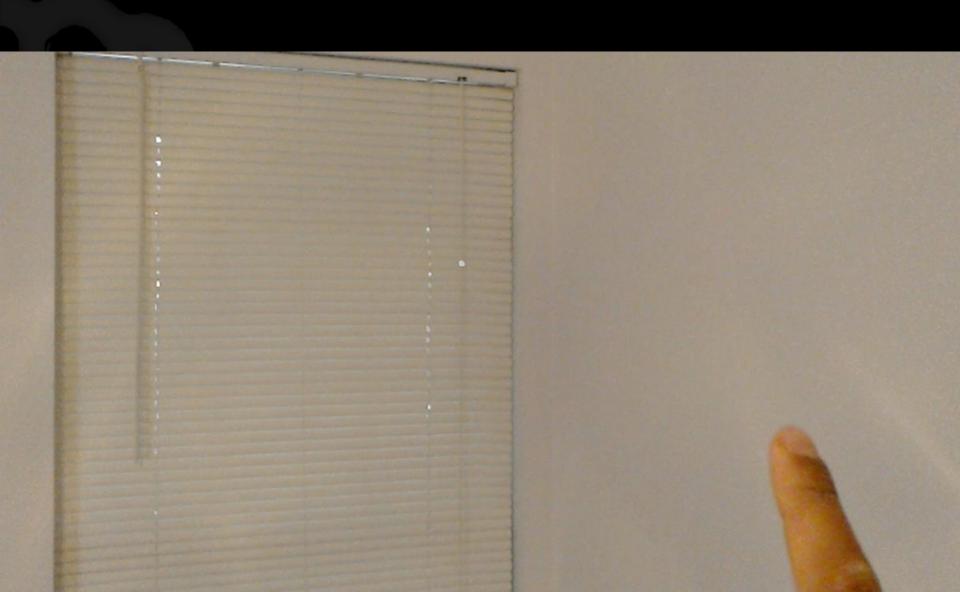


Holographic Technology

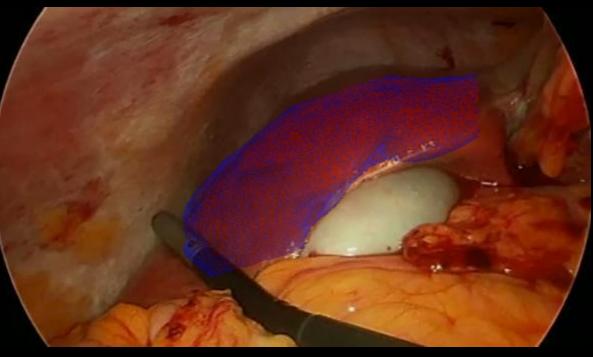




Holographic Technology

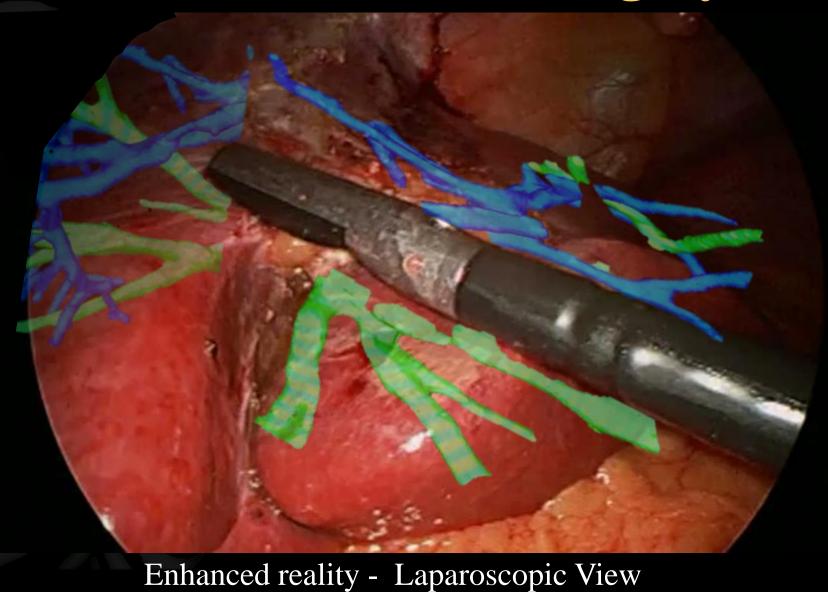


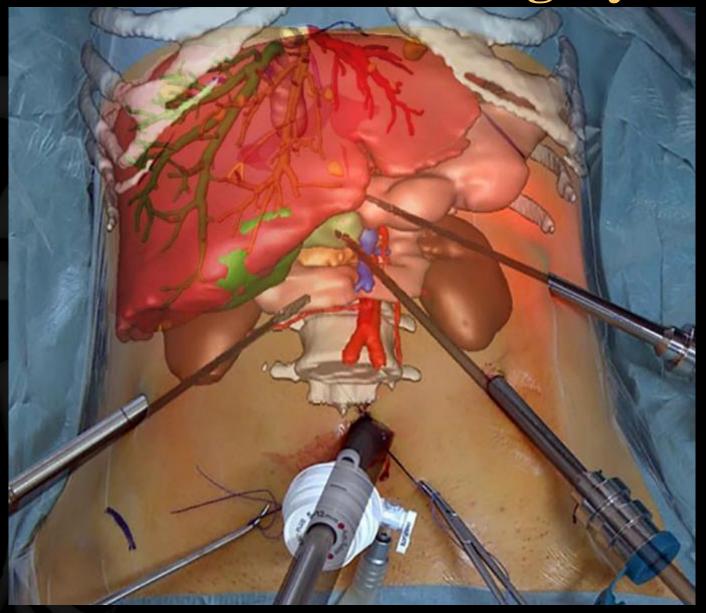




Binocular laparoscopic telescope

- 3D rendering of DICOM image
- Surface mapping with hololense technology
- Real time ongoing vascular registration by US
- RF tracking of instruments
- Virtual reality representation of intraparenchymal or intracorporeal instruments
- Laparoscopic view rendering
- Overhead of surgeon view rendering





Enhanced reality - Surgeon View (Hololense)

Advanced Image Guidance

- Systems for ablation will be commercially available in 2017
- Clear advantages over 2D US
- AIG for liver resection in very early stages of development
- Promising technology to facilitate lap resections
- "Fusion" of technologies for enhanced reality is the longer term vision

North Carolina, USA Thank You

Division of HPB Surgery



Carolinas HealthCare System Charlotte, North Carolina USA