

The DAX Probe - A Game Changer

Quality improvements in Contrast Enhanced Ultrasound CEUS
for patients with large BMI and gross fatty liver

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PURPOSE

- **OBESITY EPIDEMIC** and **FATTY LIVER**
 - a huge technical challenge to ultrasound, especially **CEUS**
- **PENETRATION** of far field structures and the ability to image them
 - Of Greater clinical impact in **CEUS** than in standard gray scale imaging
- We address **A MAJOR TECHNICAL LIMITATION IN CEUS**
 - Related to penetration and Imaging at Depth
- **FOCUS - DAX probe technology by Siemens**
 - It overcomes issues of Penetration at depth, in an obesity epidemic
 - Creates a solution - Significant quality improvement for CEUS
 - Affects clinical impact for management, diagnosis and treatment

Acknowledgement: Equipment support provided by Siemens



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METHODS/MATERIALS

- Methodology

- IRB approved study retrospective examination of 60 patients BMI > 40 and/or Fatty Liver
- Target Liver Lesion in an at-risk liver
- Standard Greyscale ultrasound and CEUS performed on any of our four machines
- DAX probe on the Siemens selected after failed CEUS on any standard probe
- Images collected
- qualitative side by side **COMPARISONS** were made

5 **COMPARISONS** between Standard Ultrasound Probes vs the DAX

Depth of Penetration

Greyscale
CEUS

Duration of Bubble Life

The bubble preservation time

Bubble Sensitivity/Resolution

The ability to see bubble enhancement as a finite dot

Enhancement/Visibility of Focal Liver Tumors

Arterial Phase(AP)
Portal Venous Phase (PVP)

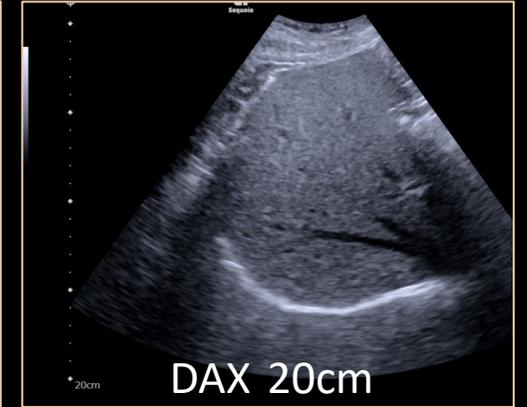
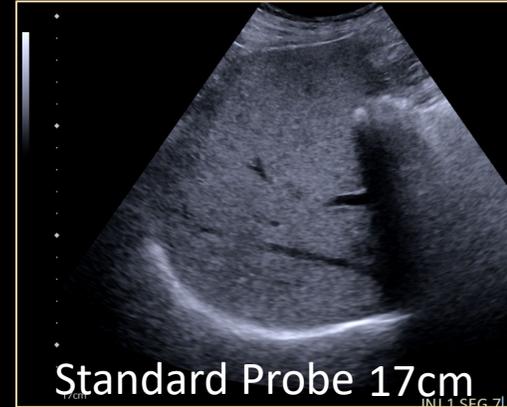
Lesion Characterization

The ability to identify/diagnose the lesions

RESULTS - DEPTH OF PENETRATION EVALUATION GREYSCALE/CEUS

Greyscale

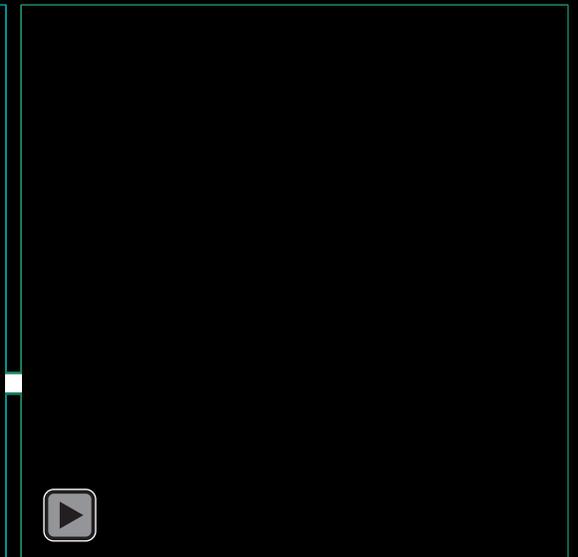
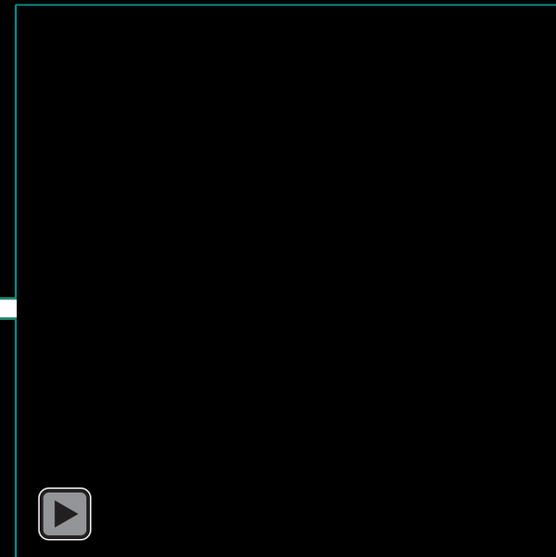
Average Difference of Greyscale Penetration Between DAX and the Standard Probe	
1.3cm	



Greyscale No significant difference in penetration

CEUS

Average Difference in CEUS Penetration between the DAX and Standard Probe	
0-1min	3.7cm
1min	3.4cm
2min	3.1cm
3min	3.1cm
4-6min	3.3cm



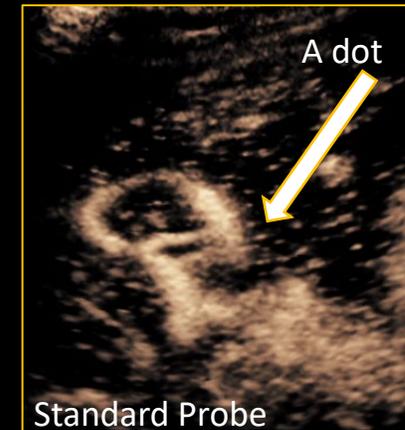
CEUS – Penetration bigger problem for CEUS

RESULTS – BUBBLE RESOLUTION

Average diameter of the enhancement from a microbubble	
DAX	0.35mm
Standard Probe	0.23mm

Better Resolution from the Standard Probe
Average difference .11mm

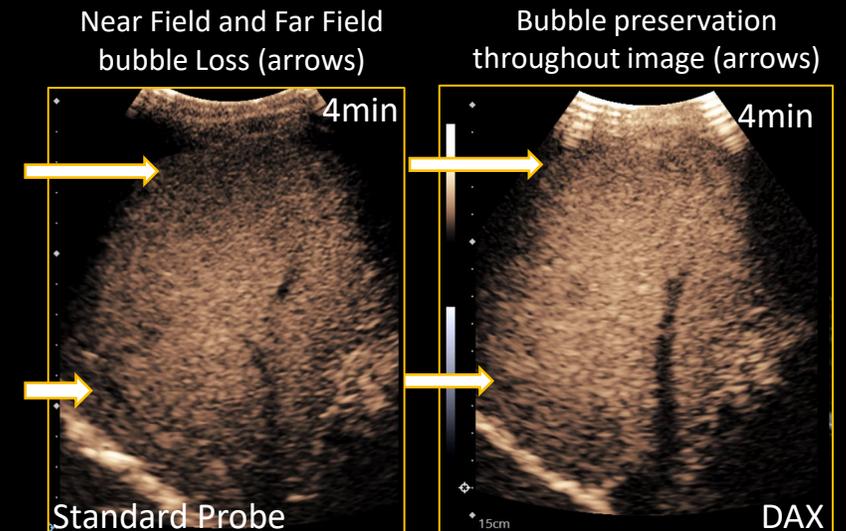
Single bubble resolution



RESULTS – BUBBLE PRESERVATION TIME

The ability of the probe to maintain bubble enhancement over time – Measured as bubble preservation	
DAX better Standard probe	42%
DAX equal to Standard probe	32%
DAX worse Standard probe	20%

DAX showed comparable and slightly improved bubble preservation



RESULTS – CEUS ENHANCEMENT OF FOCAL LIVER TUMORS - AP

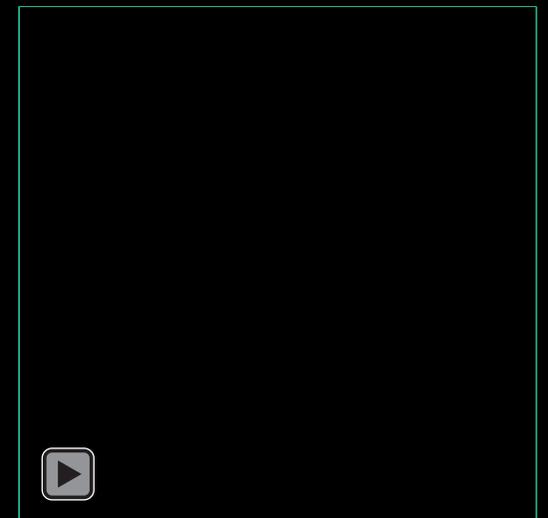
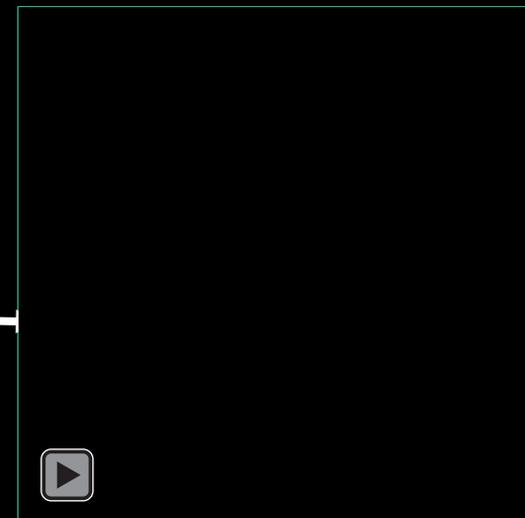
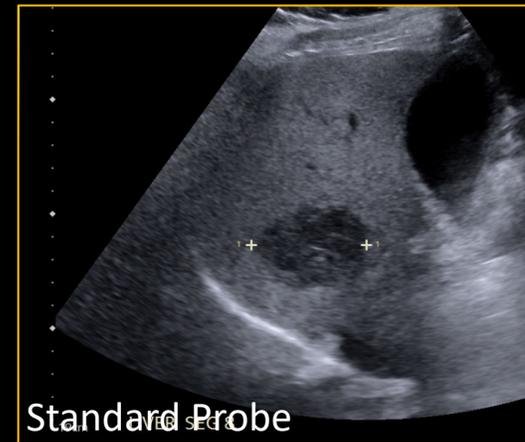
- Patients with BMI over 40 and/or fatty liver
- All Lesions were identified and measured on greyscale with both the DAX and Standard Probe

Of 60 patients
Percentage of cases with lesion enhancement visible in the AP

DAX	96.67%
STANDARD PROBE	61.67%

In the AP-
DAX showed lesion enhancement in 21 cases not observed on the Standard Probe
35% more effective at seeing liver tumor enhancement in the AP

Same Patient two probes (AP) Washin



Dropout seen on CEUS with the Standard Probe (arrow)

RESULTS - CEUS VISIBILITY OF FOCAL LIVER TUMORS - PVP

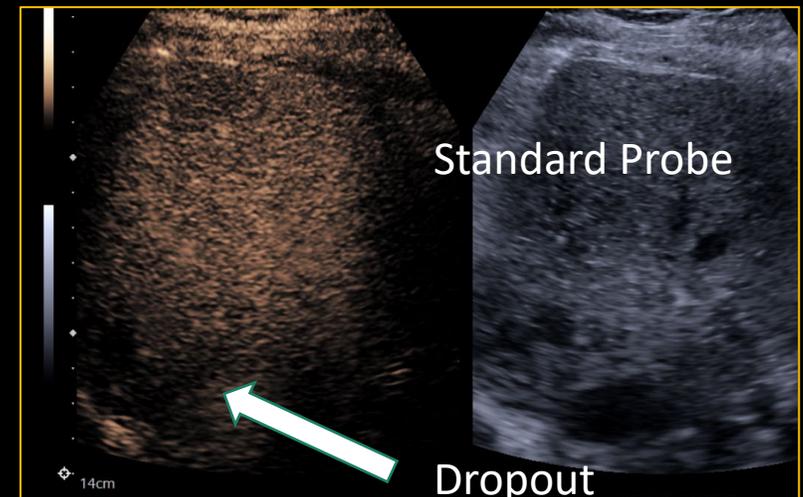
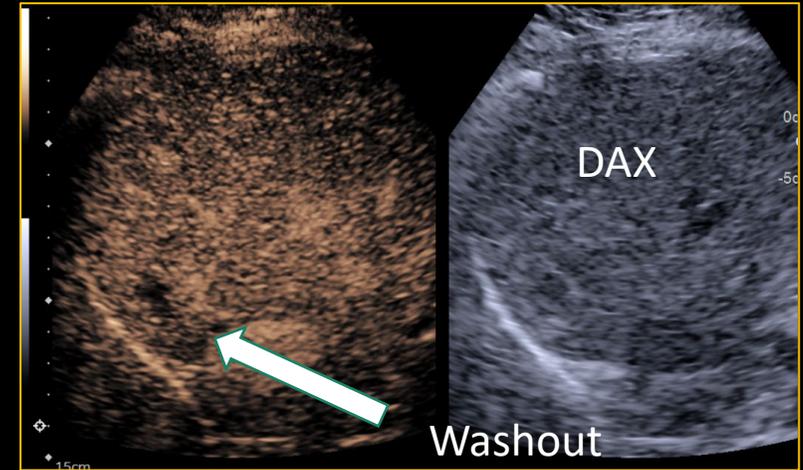
Of 60 patients
Percentage of cases with lesion visibility in the PVP

DAX	100%
Standard Probe	55%

In the PVP - Patients with BMI over 40/gross fatty liver

DAX showed lesion visibility in 27 Cases not observed on the Standard Probe
45%!! more effective at resolving liver tumors by demonstration of PVP washout

Same patient two probes Imaging at 3min

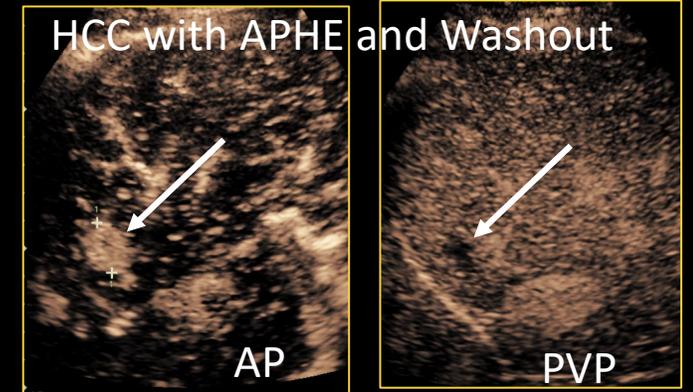
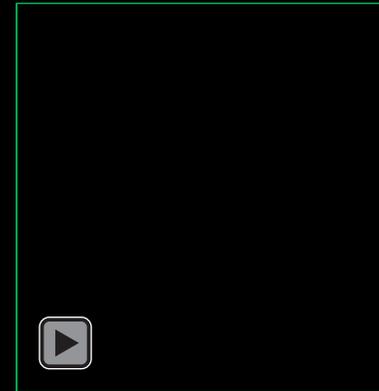
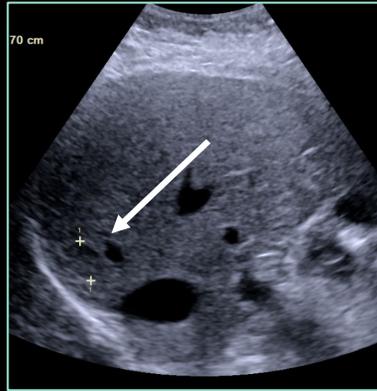


RESULTS - LESION CHARACTERIZATION

Percentage of lesions visible on greyscale that were diagnostic on CEUS

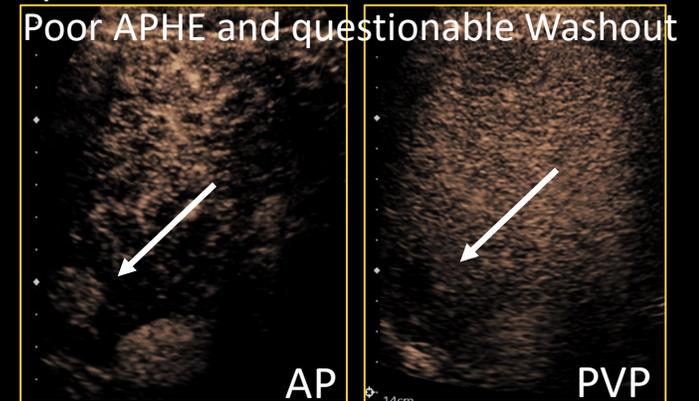
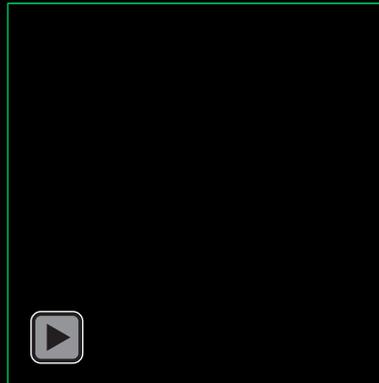
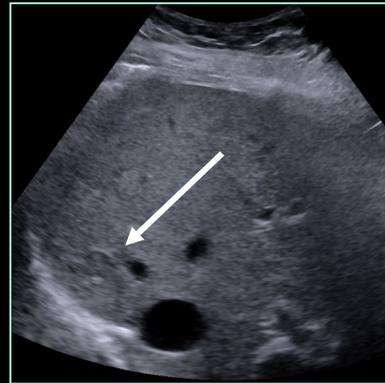
DAX AP	98.21%
DAX PVP	94.83%

DAX PROBE



STANDARD PROBE- SAME LESION/PATIENT

Standard Probe AP	87.93%
Standard Probe PVP	70.69%



On the **Standard Probe**
 Average Depth of a liver mass - 12cm
 Average Depth of an undiagnostic liver mass - 14 cm

DAX was diagnostic in 6 cases over the standard probe in the AP – **11.8% more effective**
 DAX was diagnostic in 14 cases over the standard probe in the PVP – **34.1% more effective**

DISCUSSION

All Focal Liver Lesions were easily seen on Greyscale on both the standard and DAX probe

BMI >40 and severe fatty liver are independent negative variables on depth resolution and penetration.
CEUS is much more severely affected than grayscale imaging

CEUS showed improved image optimization and quality using the DAX PROBE vs the Standard probe Including:

- The ability to penetrate in the AP and the PVP
- Increased bubble preservation time
- The ability to see enhancement of Liver masses on CEUS, especially in the PVP
- The ability to characterize/diagnose liver masses

The Improved bubble preservation time on the DAX is an important factor in characterizing lesions in the PVP especially at times over 4 mins

THE DAX had decreased bubble resolution when compared to the standard probe. The ability to see the enhancement of the bubbles as a finite dot can be used as an indicator of spatial resolution.

In patients with increased BMI, lesion detection, and diagnosis are critical. The DAX can detect a mass better, with negligible decrease in spatial resolution

CONCLUSIONS

- **Metabolic syndrome and obesity** pose a current challenge to ultrasound but specifically to image optimization and the diagnostic capability of CEUS.
- Patient factors are unlikely to change any time soon. Vendors are required to introduce unique solutions in order to provide imaging methods to meet the needs of our current populations.
- **The DAX, with its superior penetration, improved bubble resilience over time** has proven in multiple circumstances to meet these challenges with exceptional clarity and resolution.
- Due to patient weight limitation, options for CT, or MRI may not exist. The DAX probe is a necessary addition to improve Ultrasound quality specifically **CEUS** and clinical outcomes in the future. In morbidly obese patients the **DAX converts non diagnostic CEUS into high quality exams with clear resolution of pathology.**