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Problem 1:

Without the gel, the image quality is much worse than with gel. The purpose of the gel is to avoid having the ultrasound beam travel through air to reduce acoustic impedance and reflection to allow for a clear image to be produced.

Some advantages of ultrasound compared to other forms of imaging techniques is that is cheap, easy, portable, and fast to set up. It is good for real time imaging and is completely safe if the machine has safety measures. Some disadvantages include poor resolution, hard to image around bone, dependant on operators' skill, and having to use different probes and modes for different situations.

A phased array, or small footprint probe, is preferred for heart imaging as to avoid reflection from bone by getting between rib bones to image the heart. For carotid imaging a linear array probe might be preferable as it is designed to image close to the skin with high spatial resolution.

The LED indicates if the probe is turned on, off or is charging.

Problem 2:

Sponge emulates soft tissue, and the wooden plate emulates bones.

For the sponge the image is homogonous. But for the wooden plate there is a white part and a dark part after the white part.

The sponge consists of low impedance material, so we get signal from throughout the sponge. The wooden plate has high impedance, and we will therefore see a high signal from where the ultrasound beam first hits the wooden plate and is reflected. After this point there will be no more reflections because all the ultrasound beam has been silenced.

Reflections between the wooden plate and the water will make reverberation artifacts such as stripes where we get signal that is interpreted as coming from deeper structures.

We will se acoustic shadowing from the finger, where the bone in the finger will reflect a lot of the signal, but not all the signal. So, we see a shadow of the finger.

Problem 3:

When adjusting the TGC sliders, certain parts of the image become brighter or darker.

The thermal noise is stronger far away from the probe because there is less signal further away from the probe, so the noise gets amplified.

Higher frequency gives higher spatial resolution, but the signal is attenuated deeper into the tissue resulting in poor signal intensity. Low frequency gives low spatial resolution, but the signal can penetrate deeper into the tissue. Imagine your neighbour's playing music, do you hear the vocals or the bass?

When you change the focal depth, the elements in the transducer will fire in such a way that we get the thinnest part of our beam at a desired depth. The image will look the same, but the resolution of certain parts will be different, with the best resolution at focal depth.