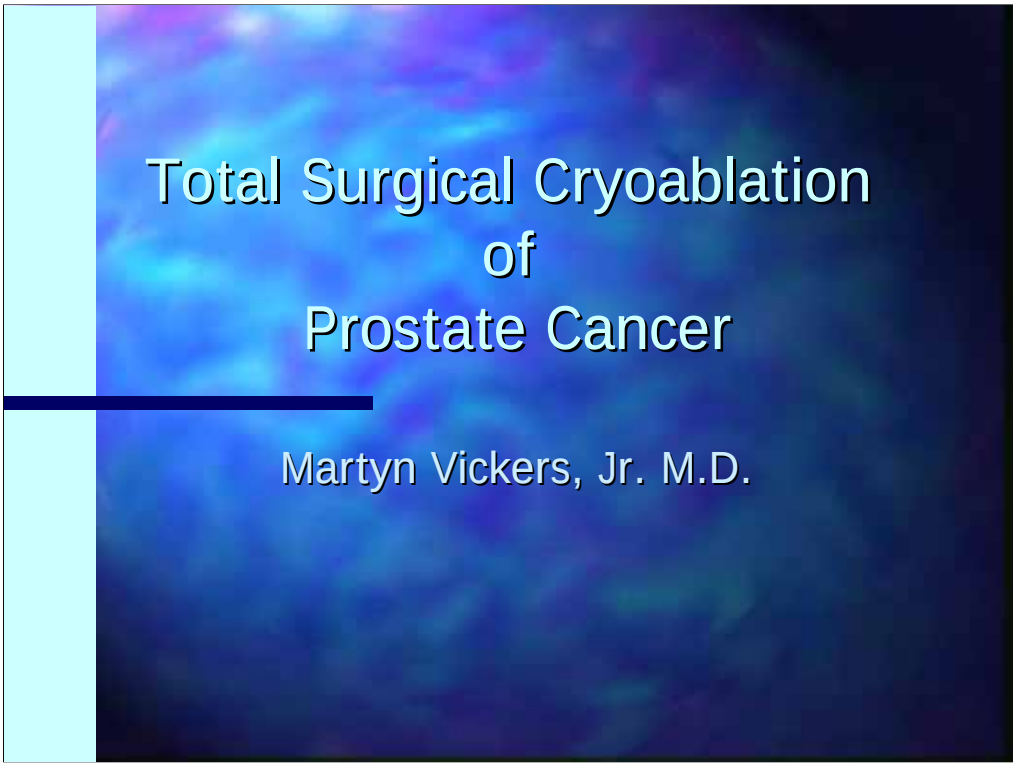
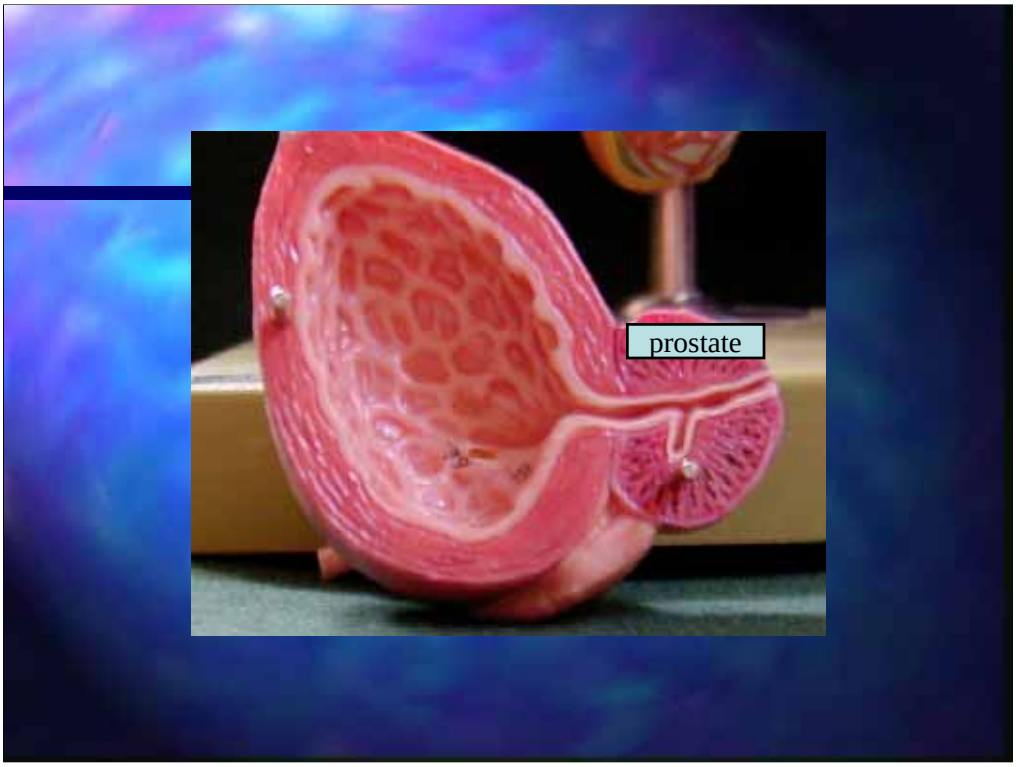
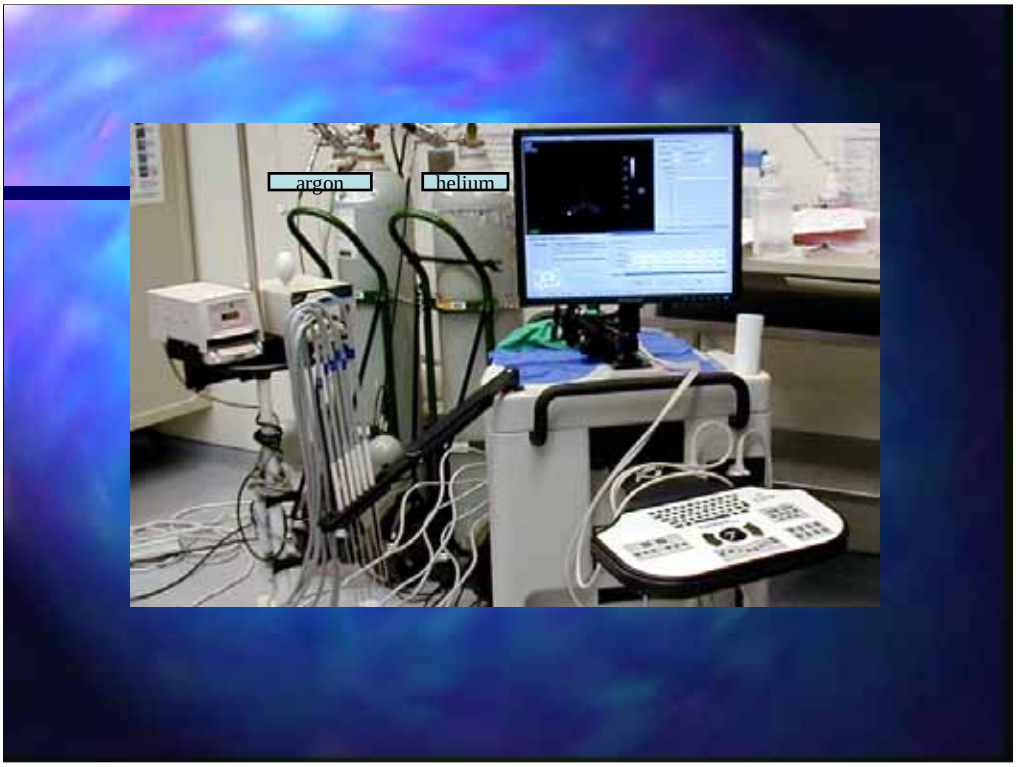


Surgical Cryoablation is a technique that utilizes extreme cold to destroy prostate cells. As argon gas rapidly expands within needles that have been precisely positioned within the prostate, the temperature adjacent to the each needle reach -40C. At this temperature, ice forms within the prostate cells and rupture their walls. The cells that line the nutrient blood vessels of the prostate are also destroyed. These vessels collapse and scar shut. Finally, the extreme cold incites a series of chemical reactions that ultimately destroys prostate cells.

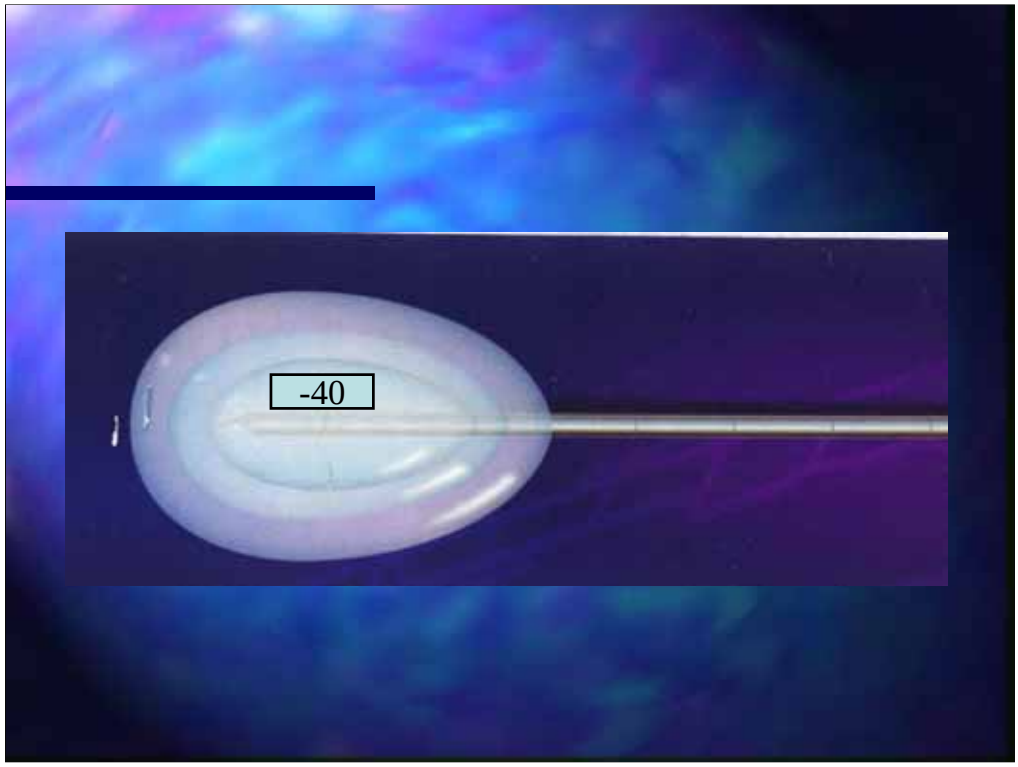
Let's look at the prostate and the structures around it, review the sophisticated equipment used to freeze the prostate, and take a step-by-step walk through total surgical cryoablation of the the procedure.



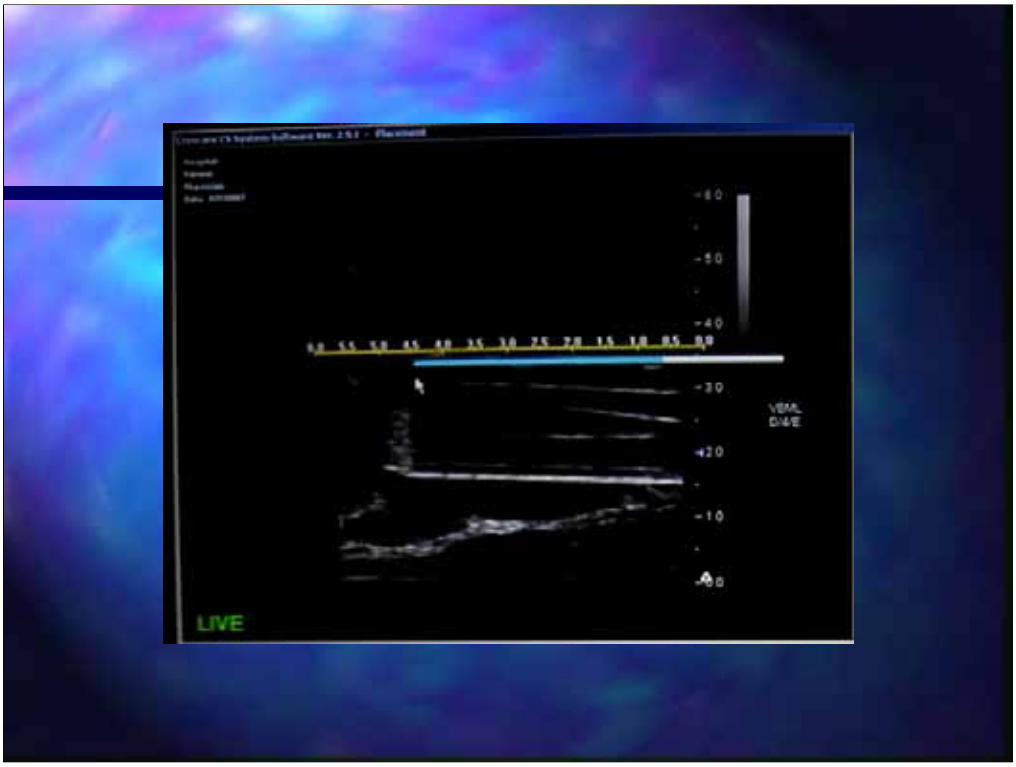
This is a side or saggital view of the bladder and prostate. The prostate touches the bladder and surrounds the urethra.



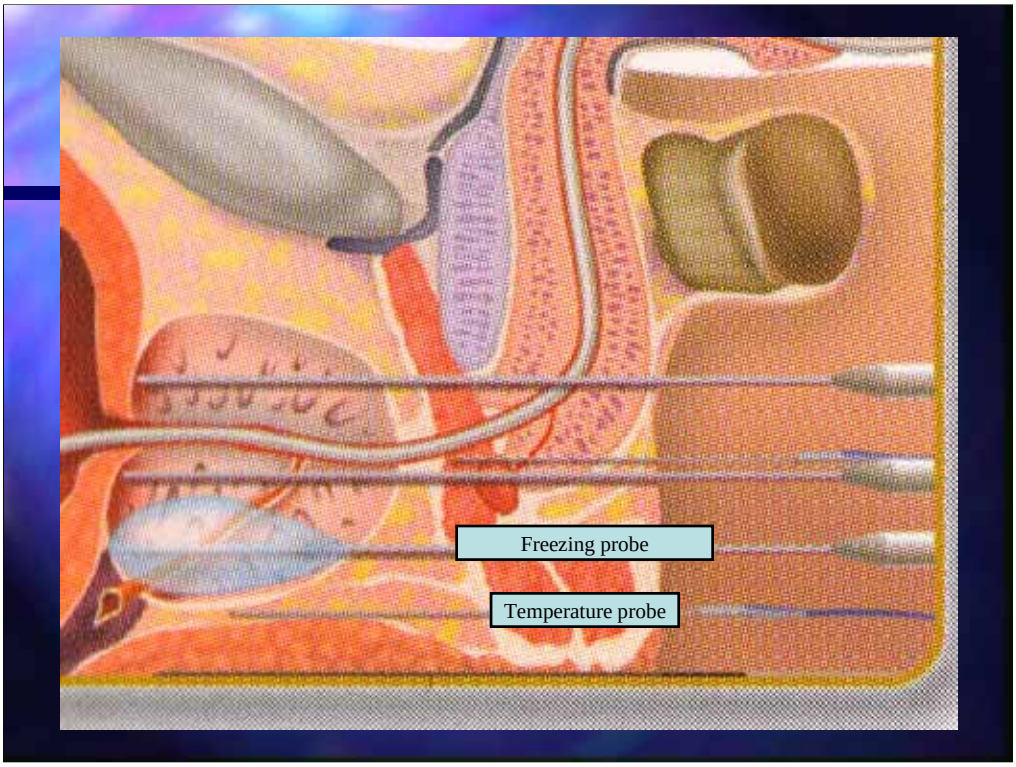
The special equipment required to perform cryosurgery includes argon and helium gas that is stored in the two large grey tanks. Argon gas freezes the prostate, helium gas thaws the prostate. The surgeon, using ultrasound, determines the the size and shape of the prostate. Based on these measurements, the computer program helps plan the placement of the probes which deliver the gases to the prostate. The ultrasound image assists in percise placement of the temperature sensing probes that surround the prostate. The delivery rate of the gases and the probe temperatures are continuously displayed in real time on the computer screen.



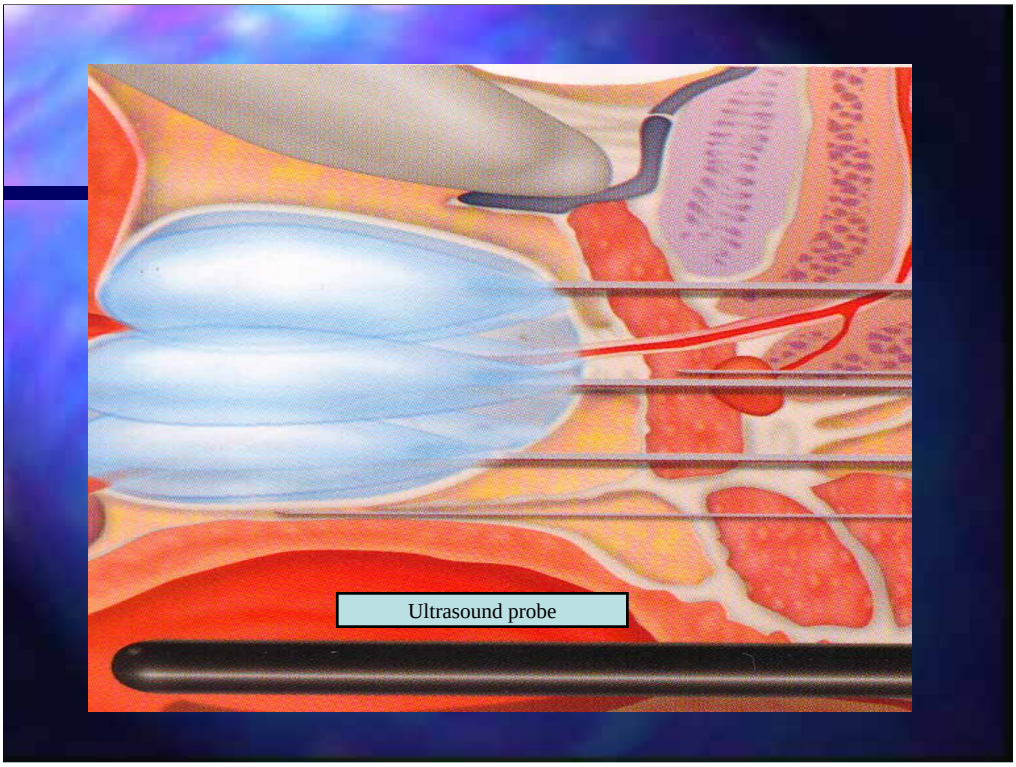
Here is the tip of a freezing probe. The inner elliptical area has temperatures of -70 to -40c. All temperatures at or below -40c kill cancer cells. The middle elliptical area has a temperature gradient of -30 to -20c. Temperature of -20c will kill cancer cells but not as reliably as at -40c. The outer ellipse has a temperature gradient of -10 to 0. At the very edge of the outer ellipse the temperature is 0c. Here ice is formed in the tissue, but the tissue is not destroyed. This ice edge can readily be seen and monitored by ultrasound.



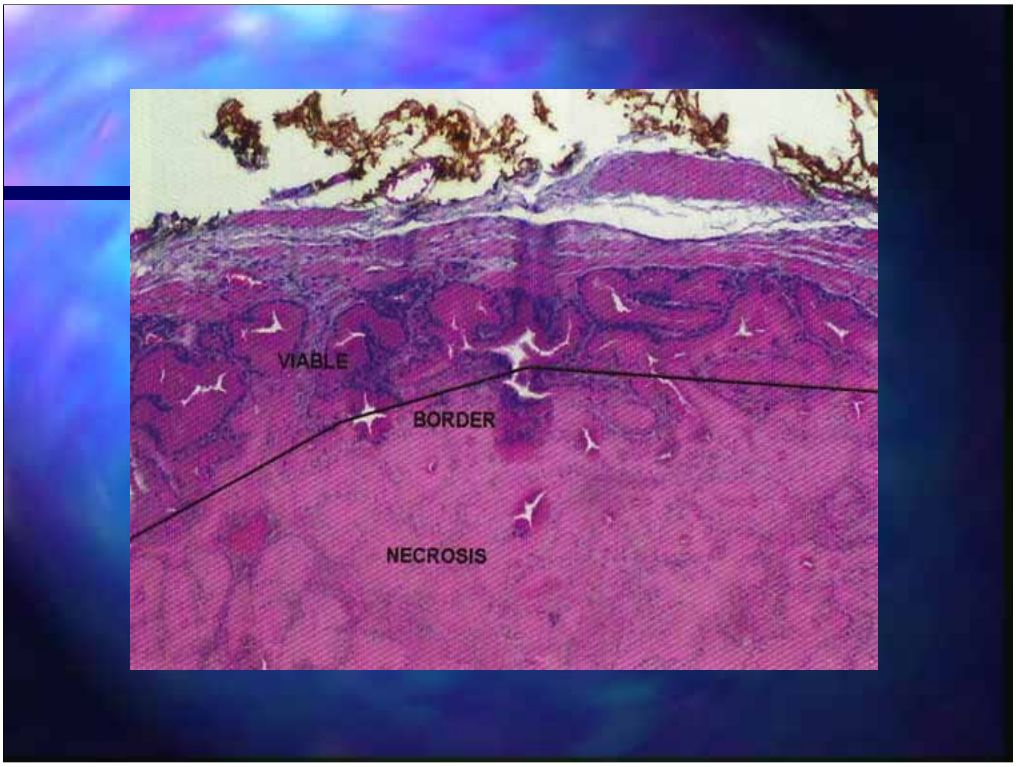
This is a side view of the prostate with two freezing probes in position. The blue discoloration on the upper probe depicts the length of the probe that can deliver lethal freezing temperatures. You can see that in this particular prostate, the freeze extends its total length.



Here the lowest freezing probe has delivered lethal freezing temperatures to the prostate. Note that an elliptical area of tissue, extending from the base to the tip of the prostate, has been frozen.

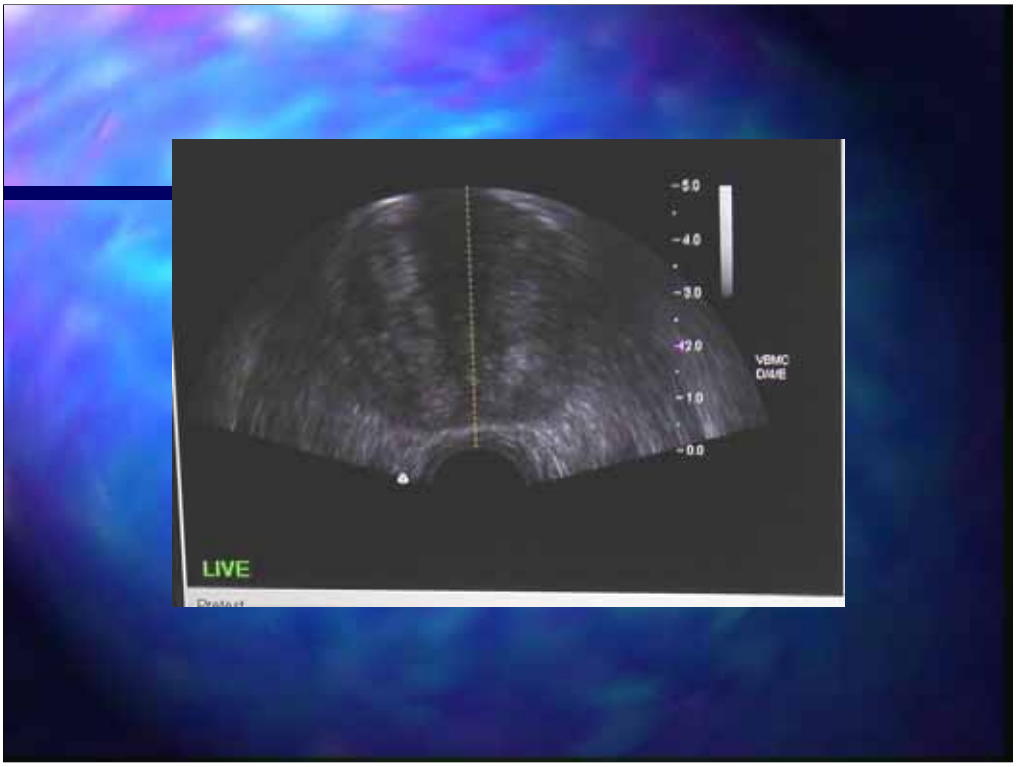


The ellipses around each freezing probe overlap and all prostatic tissue is frozen and destroyed.

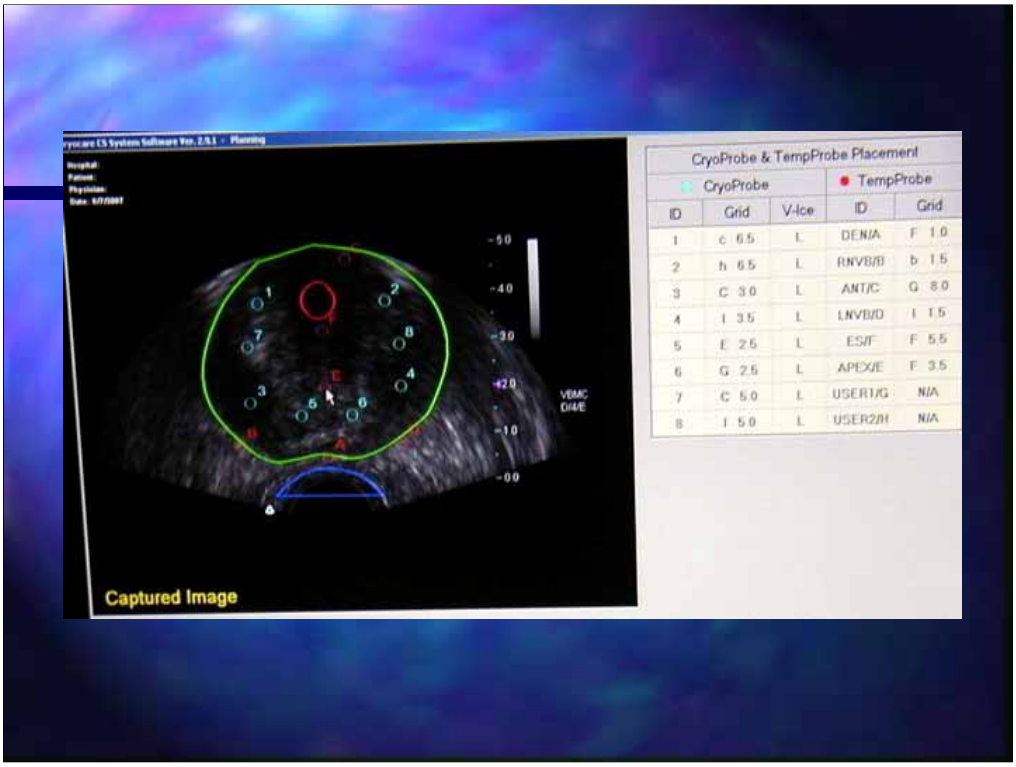


The area of tissue frozen is controlled by placement of the freezing probes, the rate of infusion of the cooling gas, and the duration of the freeze.

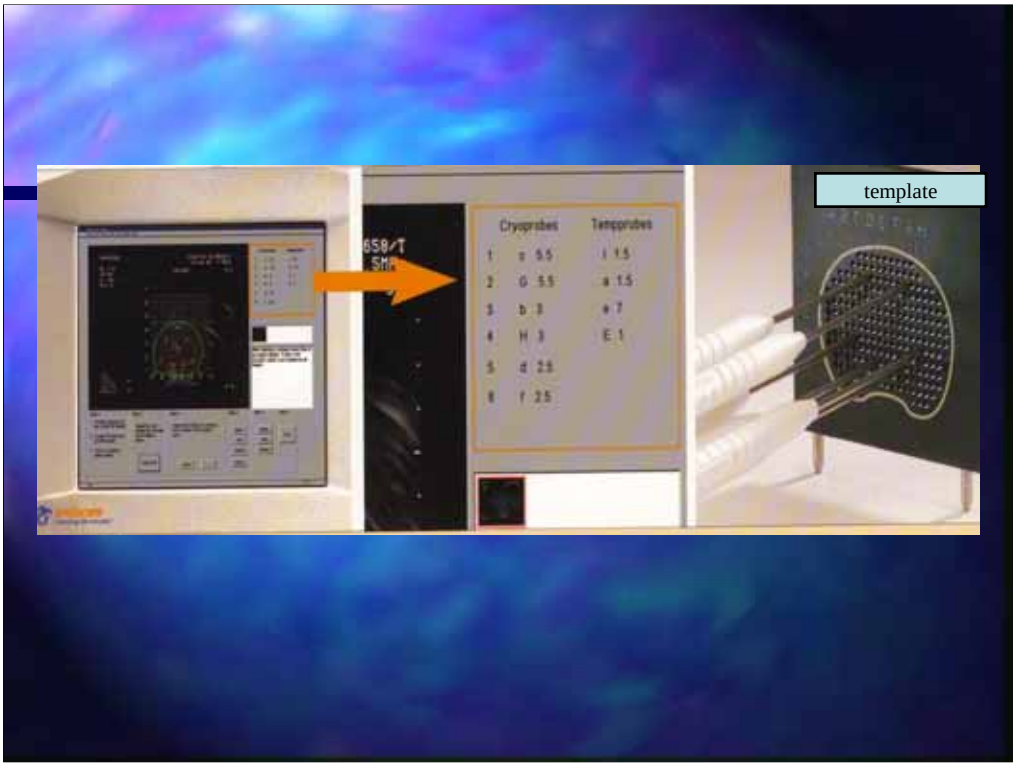
This is a microscopic slide of frozen tissue. Below the black line the tissue has been frozen, destroyed. Above the line the tissue is perserved.



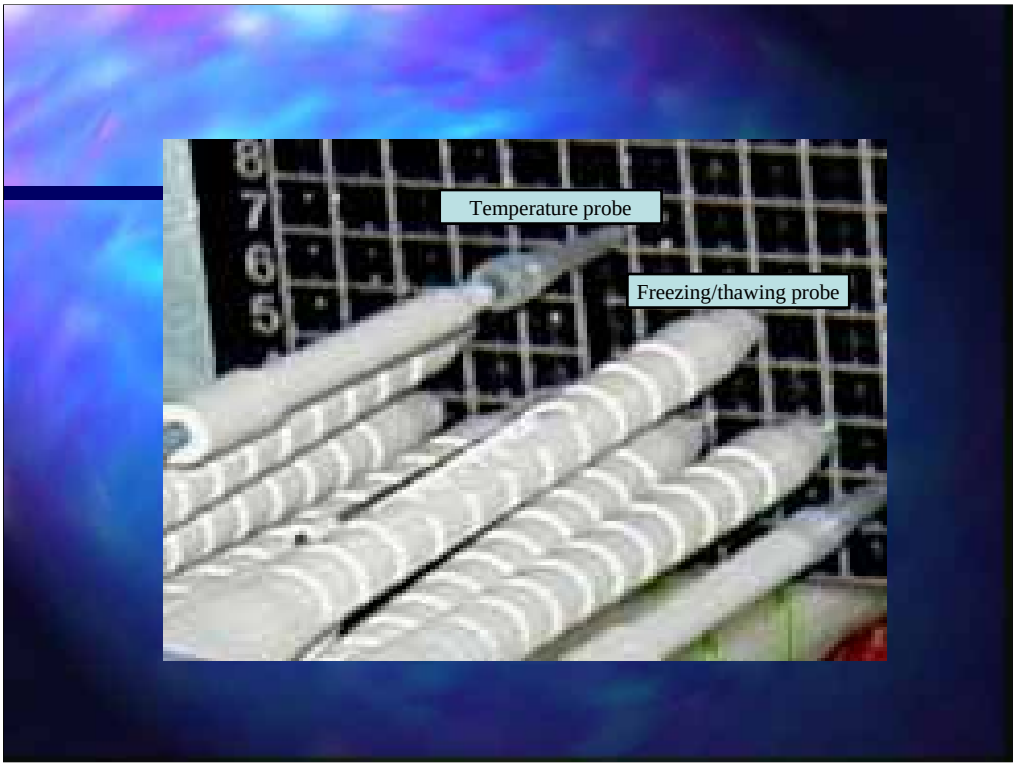
In the center of the image is the orange-shaped prostate. The ultrasound probe is in the rectum. The yellow line is used to help center the prostate.



The prostate has been outlined. Based on the size and shape of the prostate and freezing capacity of each probe, the computer suggests the ideal position for each probe. Each probe must be less than 2cm from its adjacent probe, each probe must no greater than 1 cm from the prostatic capsule, but greater than 5 mm from the urethra. Proper probe positioning allows all prostatic tissue to be frozen, while preserving the urethra, the urinary tube. The red circle outlines the urethra.

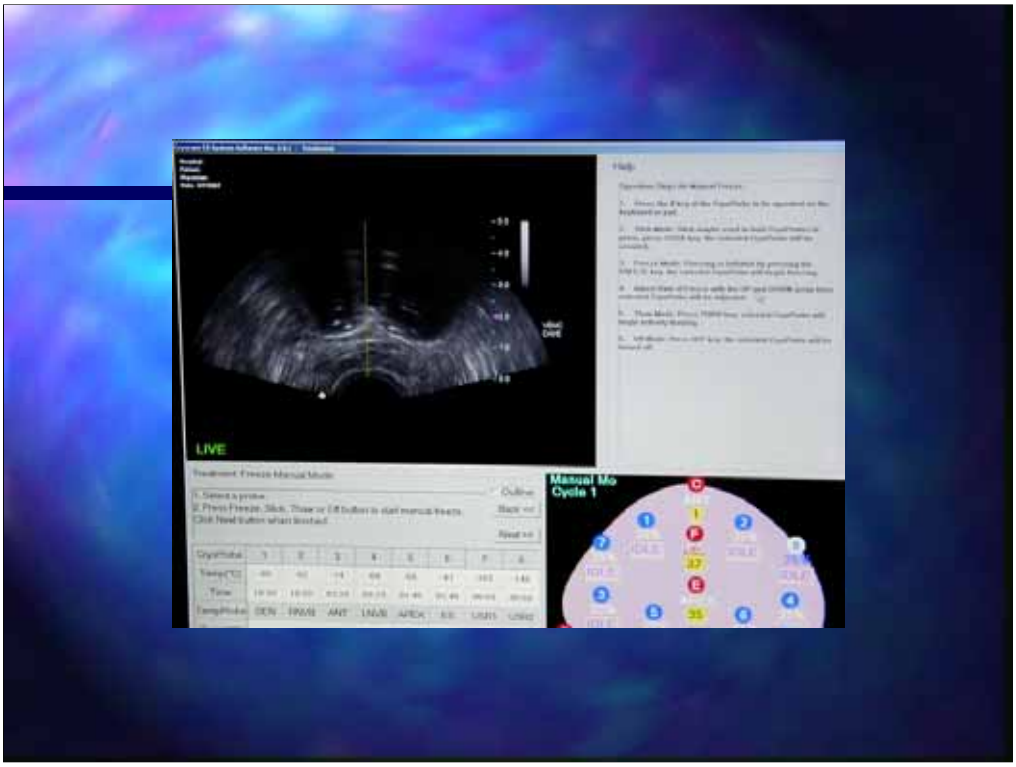


The computer program can be used as a guide for the placement of the freezing and temperature sensing probes in the numbered/lettered black template.



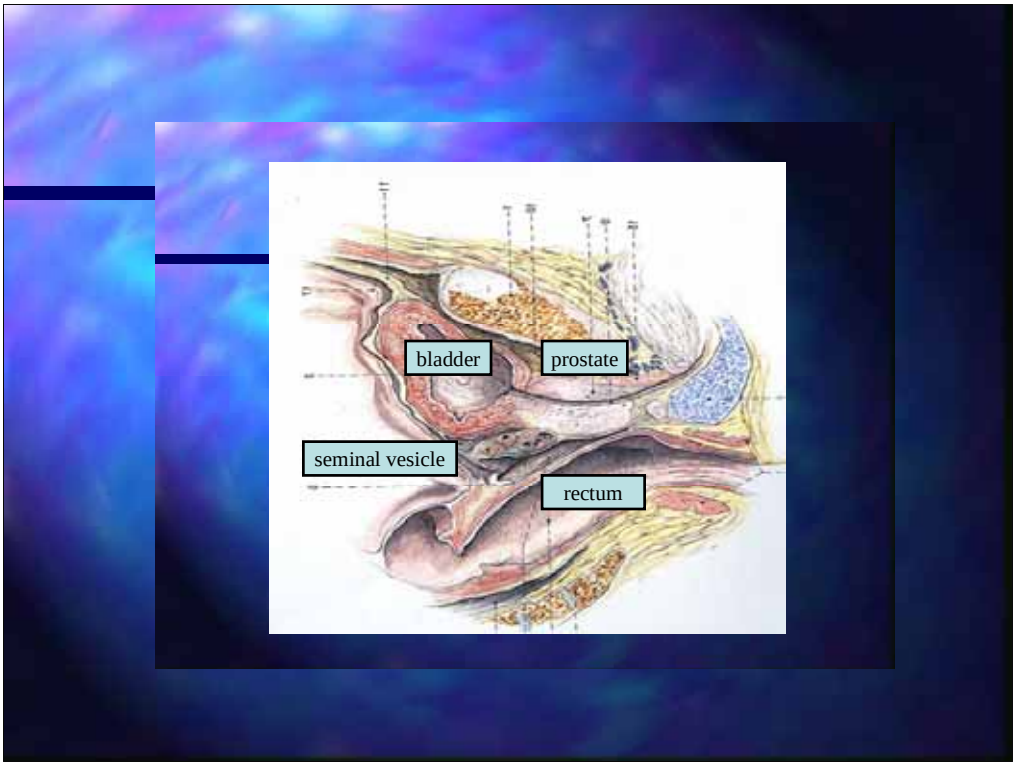
This is a picture of the template with temperature and freezing probes in position. The smaller probes are temperature sensors. The larger probes deliver the freezing and thawing gases.

The prostate is frozen from the top to the bottom of the gland (near the rectum). The black horseshoe areas, on the left and right, have been frozen. The grey area in the middle is viable prostatic tissue.



A pyramidal area of viable prostatic tissue remains. This tissue will be frozen/destroyed within 3 minutes by argon gas delivered by probes 5 and 6.

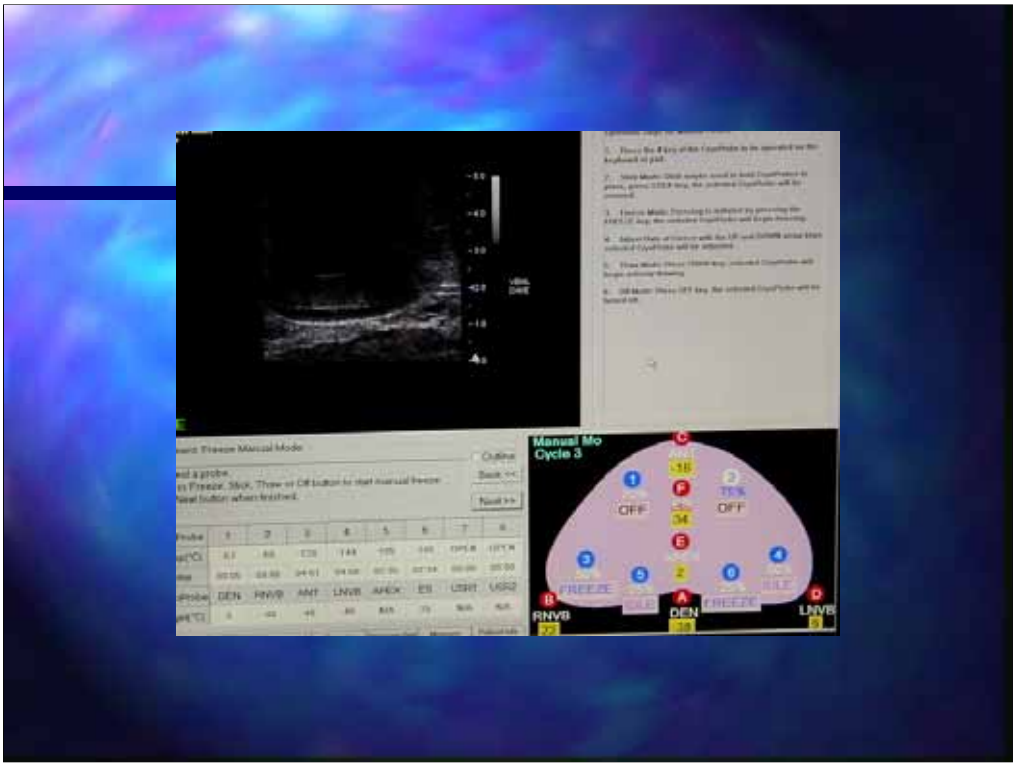
All prostatic tissue has been frozen. The edge of the ice ball is just above the rectum.



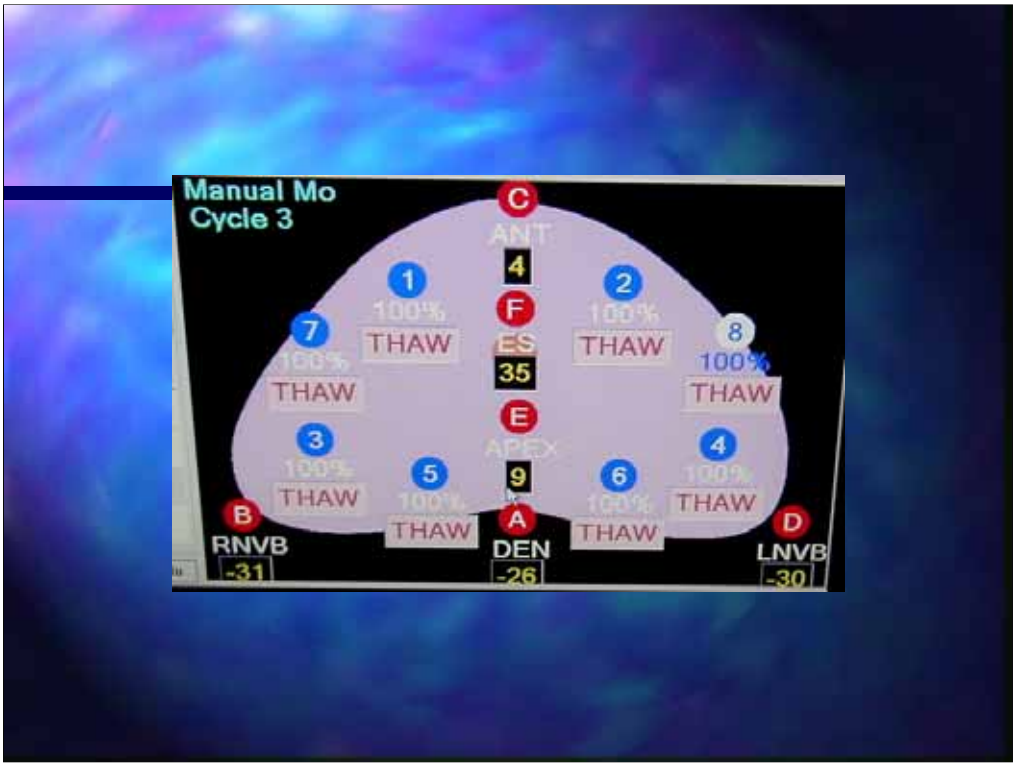
This is a side view of the prostate, urethra, bladder, and rectum. The seminal vesicle sits between the bladder and rectum. The rectum is drawn up toward the prostate in the area of the external urethral sphincter.

Here is side-view of the prostate. Freezing has begun. The edge of the ice ball is the curved white line.

More prostatic tissue has been frozen. The leading edge of ice is approaching the rectum.



The freezing edge has reached the tissue that separates the prostate from the rectum.



At this point, helium gas is used to thaw the prostate. After 10 minutes of a helium infusion, the prostate ice disappears. The freezing probes and temperature sensing probes can be seen and will be repositioned if the previous freeze/thaw cycle moved their tips away from the base of the prostate.

Next a second freeze is performed. Repetitive freezing enhances destruction of prostate cells.

After the second freeze, all probes are removed. The warming catheter is replaced with a three way catheter that allows a warm solution to continuous bathe the bladder as the prostate slowly thaws.

The patient is awakened and transferred to the recovery room for postoperative care.