

Rabin, Y. (2001) "Imaging of Breast Cryosurgery," in: Atlas of Cryosurgery (Korpan, N.K., Ed.), Springer-Verlag, Vienna, Austria, pp. 344-353

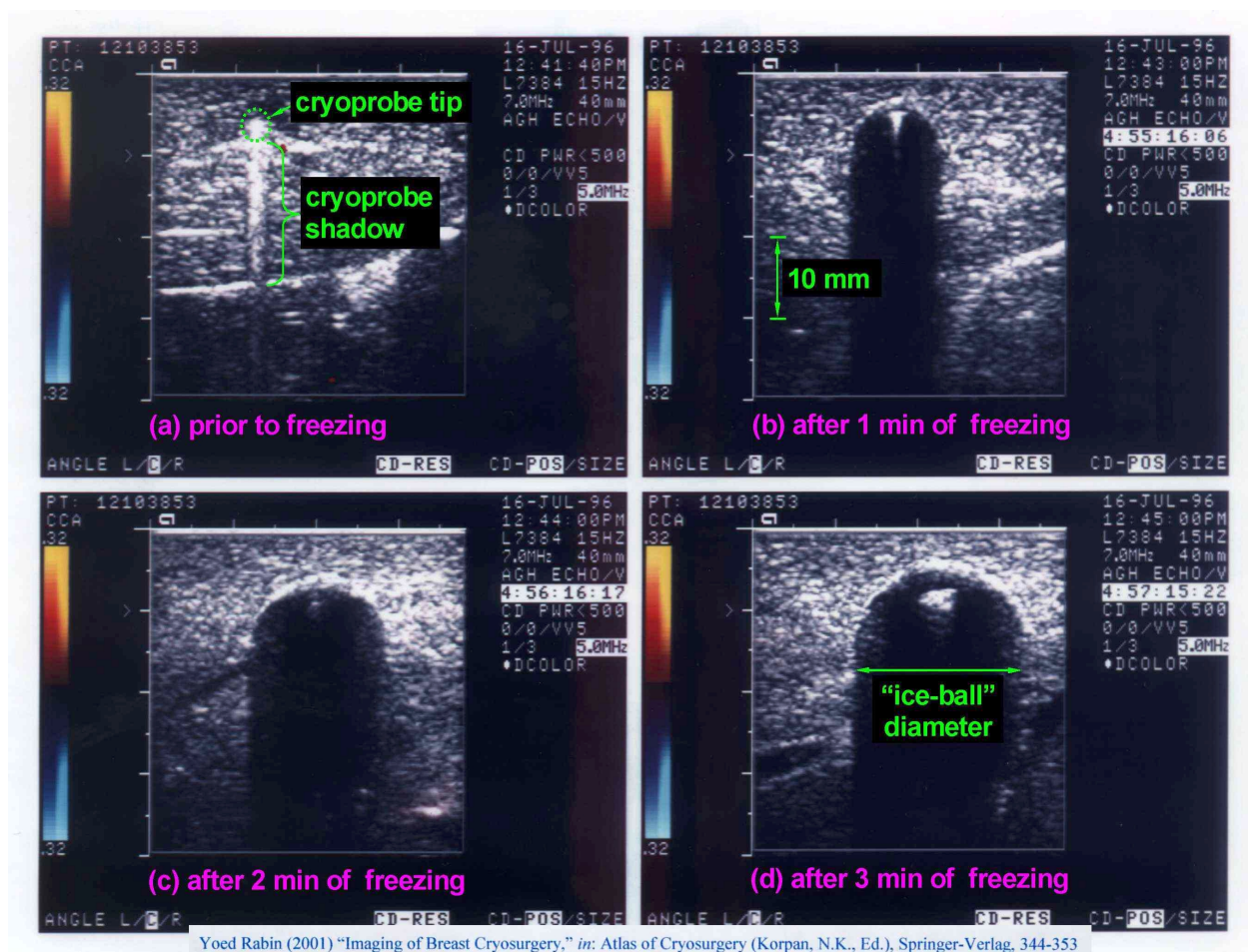


Figure 16.1.1: Ultrasound imaged "ice-ball" formation in a sheep breast model using 7MHz linear array transducer (Rabin et al., 1999). The frozen region appears as a dark area in the ultrasound image. The cryoprobe is placed perpendicular to the ultrasound transducer (to the monitor), the ultrasound transducer is applied from above and, therefore, the cryoprobe shadow is projected downwards, as illustrated in Fig. 16.1.1(a). A measurement of the "ice-ball" diameter is illustrated in Fig. 16.1.1(d), which appears to be about 2 cm after 3 minutes of cryo-operation. The cryoprobe applied in this study has been designed specifically for the application of minimally invasive breast cryosurgery and is constructed of hypodermic tubes in a diameter of 1.15 mm (Rabin et al., 1997).

## References

- Rabin, Y., Julian, T.B., and Wolmark, N., (1997) "A Compact Cryosurgical Apparatus for Minimal-Invasive Cryosurgery," *Biomedical Instrumentation & Technology*, 31:251-258.
- Rabin, Y., Julian, T.B., Olson, P., Taylor, M.J., and Wolmark, N., (1999) "Long-Term Follow-Up Post-Cryosurgery in a Sheep Breast Model," *Cryobiology*, 39:29-46

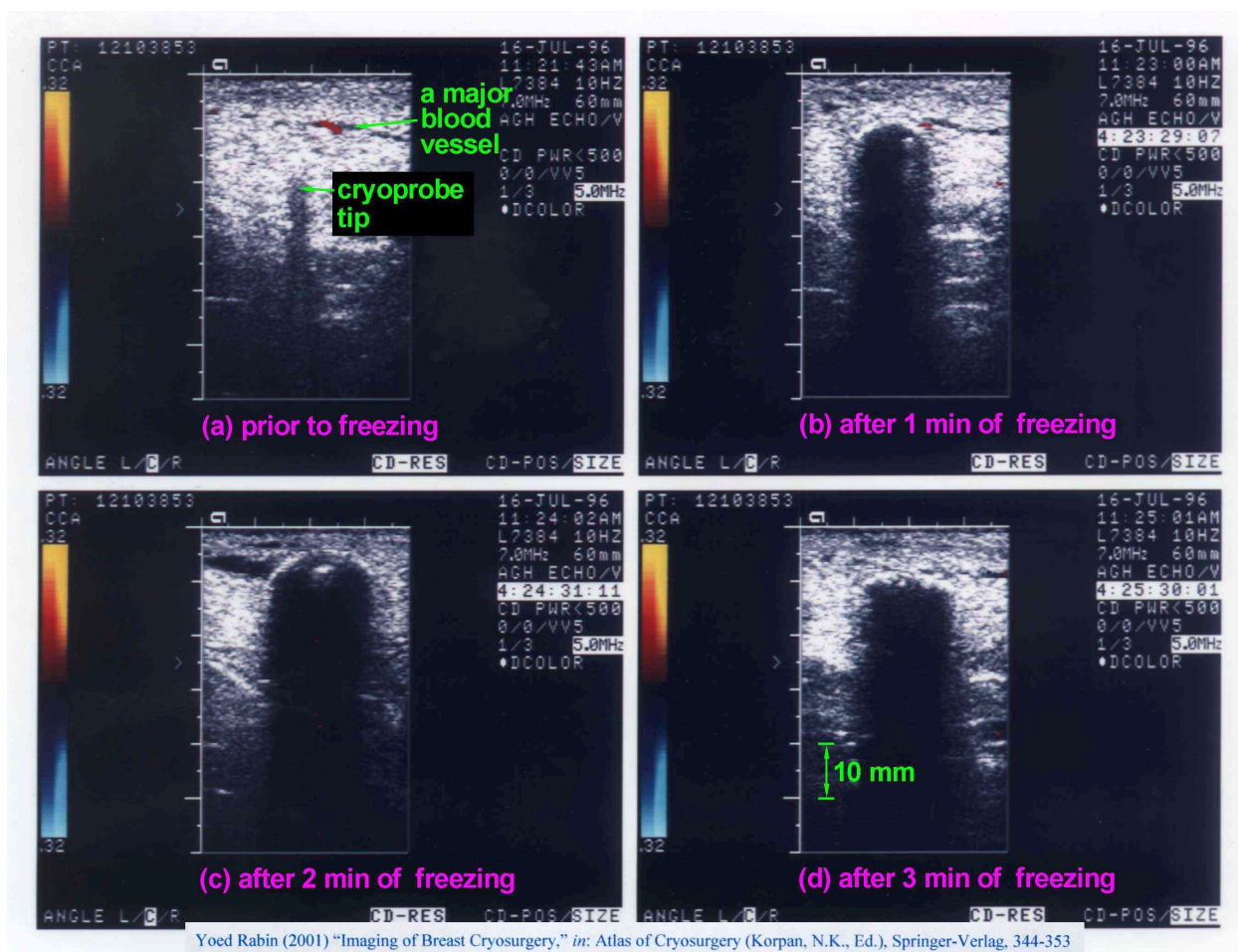


Figure 16.1.2: Ultrasound imaged "ice-ball" formation in a sheep breast-model using 7MHz linear array transducer (Rabin et al., 1997; Rabin et al., 1999). The cryoprocure is performed adjacent to one of the major blood vessels of the breast, where the red and blue colors indicate blood flow in Doppler ultrasound imaging, as pointed in Fig. 16.1.2(a) prior to freezing. The non-circular contour of the "ice-ball" adjacent to the blood vessel is a result of the heating effect of the blood flow, as can be seen after 3 minutes of freezing, Fig. 16.1.2(d). The purple dashed line after 7 minutes of freezing, Fig. 16.1.2(h), indicates the frozen interface that would have probably developed in the absence of the major blood vessel. The blue dashed line after 9.3 minutes, Fig. 16.1.2(i), represents the location of the already frozen blood vessel. Some blood flow is still shown adjacent to the top-left contour of the frozen region after 9.3 minutes of freezing, due to the presence of an unfrozen blood vessel branch. Echo measurements at the location of the unfrozen blood vessel branch are shown in Fig. 16.1.2(j).

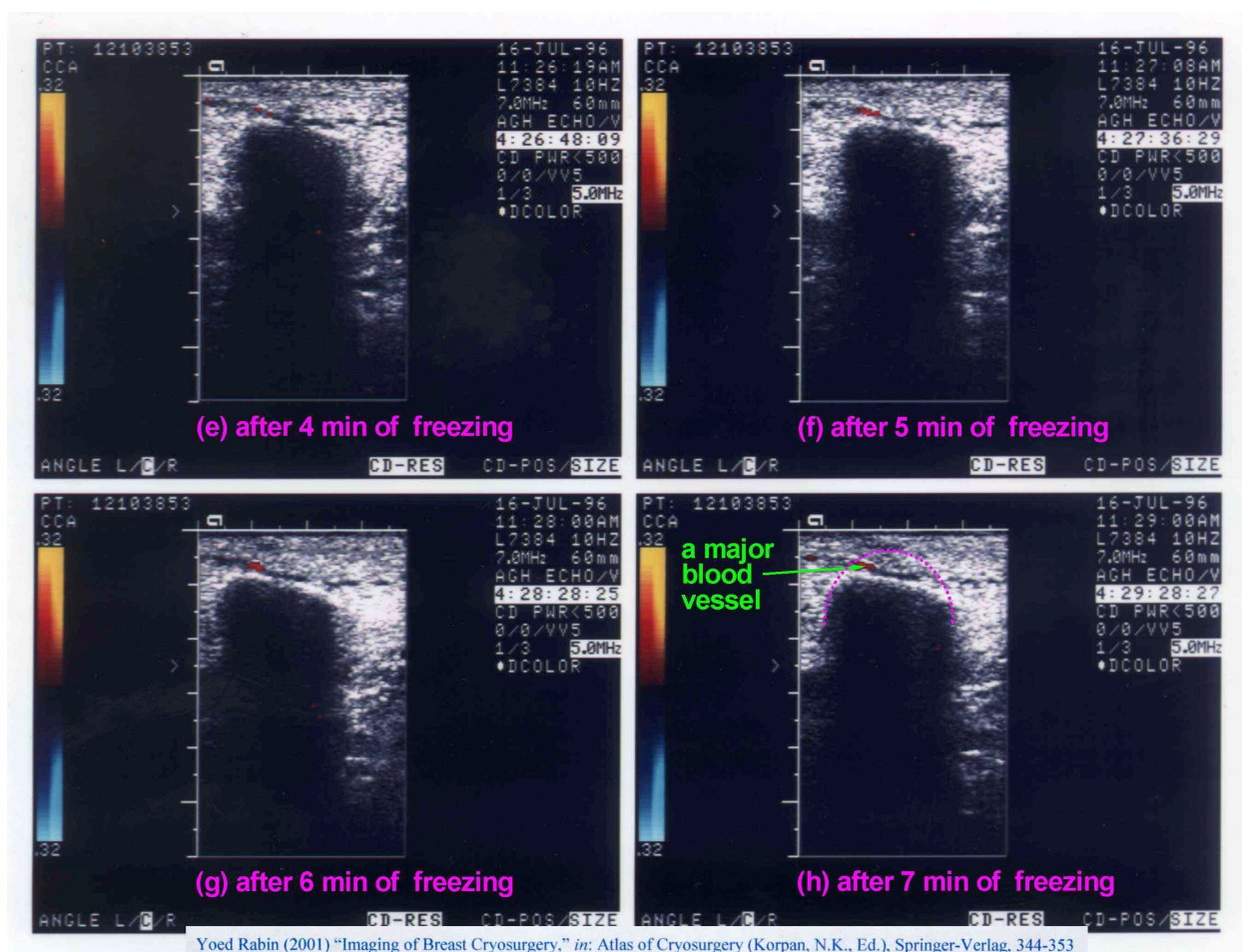


Figure 16.1.2: Ultrasound imaged "ice-ball" formation in a sheep breast-model using 7MHz linear array transducer (Rabin et al., 1997; Rabin et al., 1999). The cryoprocure is performed adjacent to one of the major blood vessels of the breast, where the red and blue colors indicate blood flow in Doppler ultrasound imaging, as pointed in Fig. 16.1.2(a) prior to freezing. The non-circular contour of the "ice-ball" adjacent to the blood vessel is a result of the heating effect of the blood flow, as can be seen after 3 minutes of freezing, Fig. 16.1.2(d). The purple dashed line after 7 minutes of freezing, Fig. 16.1.2(h), indicates the frozen interface that would have probably developed in the absence of the major blood vessel. The blue dashed line after 9.3 minutes, Fig. 16.1.2(i), represents the location of the already frozen blood vessel. Some blood flow is still shown adjacent to the top-left contour of the frozen region after 9.3 minutes of freezing, due to the presence of an unfrozen blood vessel branch. Echo measurements at the location of the unfrozen blood vessel branch are shown in Fig. 16.1.2(j).



