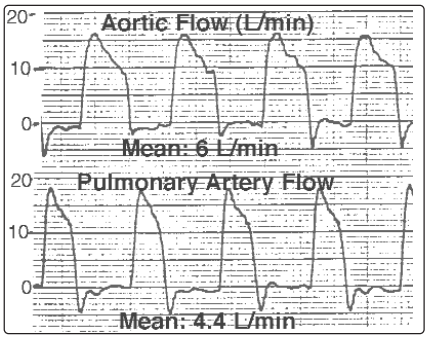
Transonic Surgical Protocol #42
5/90

Using Perivascular Transit Time Flowprobes on Vascular Prostheses

Fig. 1: Total Artificial Heart developed at University of Utah.

Fig. 2: Perivascular probe mounted at junction of graft and vessel.



Aortic and pulmonary arterial flows recorded with 24 mm perivascular flowprobes on pre-clotted Dacron grafts anastomosed to natural vessels on a University of Utah Total Artificial Heart.

References

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History

Early investigations conducted by Transonic Systems indicated that perivascular probes could not be used on expanded polytetrafluoroethylene (GORTEX) and Dacron vascular prostheses. Without pretreatment, these materials greatly attenuated acoustical signal strength. The cause for this attenuation was thought to be air trapped in the interstices of the PTFE and between the fibers of Dacron.

Despite this problem, we continued to receive occasional reports of our flowprobes operating properly on chronically implanted prosthetic grafts. This would only be possible if the air were removed. On further investigation, we found that there has been a fair amount of research on methods of removing air. This was primarily because entrapped air causes other side effects such as increased thrombogenicity and slower endotheliazation.

Dacron

Dacron prosthetic grafts are composed of knitted or woven fibers and rely upon clotting to maintain graft integrity. As the space between the fibers is filled, air is displaced. This reduces ultrasonic attentuation and allows successful transit time measurements. One technique recommended is to clot the graft by soaking the grafts with blood before implantation.

PTFE

Expanded polytetrafluoroethylene grafts (GORTEX and IMPRAFLEX), are somewhat more difficult to work with. Early technique for the removal of air required special equipment for pressurization.

The following procedure may be implemented with easily obtainable materials.

1. Remove the rubber stopper from a blood collection tube.
2. Place the graft in the tube and fill and tube with ethanol.
3. Place a needle (22 ga.) through the stopper and replace the stopper allowing fluid to exit through the needle.
4. Evacuate as much air as possible by withdrawing with a 20 cc syringe on the needle.
5. Repeat this procedure with several tubes of sterile saline.
6. Rinse the graft 20 minutes later with the prepared saline. The alcohol has less surface tension and aids in the replacement of air spaces with fluid. The graft should change from opaque white to translucent if sufficient air has been removed. Care (frequent irrigation) must be taken to prevent air from re-entering the graft upon implantation. Preliminary *in vivo* results have shown frequent agreement between flow measured in the native vessel and the adjacent prosthetic graft.

PTFE

One good indicator of the effectiveness of the air removal procedure is to use Test Mode on flowmeters to compare the amplitude of the received signal of the probe on the graft to that received on a vessel or in a water bath. If the signal strength is significantly lower, air is not sufficiently removed. We also recommend that the flow in the graft be validated by comparing it to that of the connecting native vessel or by performing an *in vivo* calibration at the end of the experiment.

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