In Situ Fenestration: Implications for Endograft Durability

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Purpose

Experimental and first clinical data on in situ fenestration of the Zenith endograft have previously been reported by our group. Further experiments have been undertaken to test the applicability of this technique to other fabrics, the stability of the resultant fabric tear, and the potential damage to the endoskeleton by the blades of the cutting balloon.

Methods

In situ fenestration, according to published methods, was performed on Gore and Cook endografts in an aortic model with a side branch. Tensile strength measurements were performed on PTFE and Dacron harvested from these endografts. The fabric was tested before and after fenestration.

Corrosion testing of a nitinol stent was performed by immersing the stent in a saline solution, scratching the nitinol with a needle and measuring depassivation voltages and repassivation times using a computer-controlled digital voltmeter.

Results

Compared to Dacron, PTFE is easier to perforate and cut; the puncture can be readily dilated with a standard angioplasty balloon and does not require a cutting balloon. The static load needed to rupture nonperforated Dacron is 160 N and nonperforated PTFE 120 N. The static load needed to rupture Dacron and PTFE after in situ fenestration is less, approximately 100 N; however, this is much greater than anticipated in vivo forces.

The technique of in situ fenestration may damage the oxide layer of a nitinol endoskeleton. The mean depassivation after scratching nitinol with a needle used at in situ fenestration is 90 mV. The repassivation time is 17 minutes. The mean depassivation after in vitro stent fracture is 300 mV and the repassivation time is 18 minutes.

Conclusion

Static fabric testing of Dacron and PTFE suggests that in situ fenestration is not likely to result in a propagating fabric tear. Scratch testing of nitinol shows that there is the potential for initial damage during in situ fenestration; however the rapid repassivation suggests that this is unlikely to compromise long-term durability. Further tests in a pulsatile environment are necessary and are ongoing in our laboratory.