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Short Communication

SMART Tubing Presents an Increased Risk of Disconnection During Extracorporeal Circulation

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Abstract: A number of products exhibiting biocompatible features have been developed for use in extracorporeal blood circuits during cardiopulmonary bypass procedures. While attention has been focused on biocompatibility features of the blood-circuit interface, a number of issues applicable in clinical use of these circuits have arisen. Surface Modifying Additive Technology (SMART; Cobe Cardiovascular, Arvarda, CO) is one such technology. In this product, the structure of normal polyvinylchloride (PVC) tubing is altered through the blending of two copolymers to give a more biocompatible blood to plastic interface. In this study, we examined the in vitro mechanical ability of random samples ($n = 10$) of SMART and standard PVC tubing to withstand axial tension when the tubing was placed over a single barb of a connector. The tension required to remove the SMART tubing from the connector (83.3 ± 7.3 [SD] N), was significantly less than standard PVC tubing (115.6 ± 15.9 N; $p < .0001$, unpaired t test). The SMART tubing exhibited a 28% reduction in tubing to connector adhesion, which may have a significant effect on extracorporeal circuit disconnection and overall patient safety. **Keywords:** cardiopulmonary bypass, biocompatibility, surface modification, perfusion circuitry, accident prevention. *JECT. 2005;37:400–401*

Over recent years, the medical technology and plastics industries have developed improved biocompatible products to reduce the deleterious effects of blood contact with nonendothelial surfaces. Surface Modifying Additive Technology (SMART; Cobe Cardiovascular, Arvarda, CO) is one such technology designed to minimize platelet activation caused by synthetic surfaces and thereby lessen the effects of blood interaction (1–3). SMART tubing is produced by copolymer blending of polycaprolactone and polysiloxane with base polyvinylchloride (PVC) (4,5). These copolymers form a triblock compound that migrates to the surface during manufacturing. Microdomains of alternating positive and negative charges are created along the surface of the tubing, rendering the surface hydrophilic. This treatment also makes the tubing feel more slippery compared with standard PVC tubing. While it seems to slide onto barbed tubing connectors more readily, it may also slide off with important and dramatic consequences. There has been a recent incident reported where the arterial line disconnected from the arterial filter during cardiopulmonary bypass, even though cable ties had been used to secure the tubing (6). A similar disconnection at our institution, although this time on the low-pressure side of the circuit, prompted the current study.

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MATERIALS AND METHODS

Random samples ($n = 10$), of 40-mm lengths of SMART tubing (0.372 × 0.094 in) and standard cardiac PVC tubing and were obtained from Cobe Cardiovascular. The tubing, at room temperature, was carefully placed on one end of a 0.372-in Cobe connector held securely in a 4-in engineers vice, so that the end of the tubing was uniformly just past the first barb of the connector. The free end of the tubing was attached to a spring balance

with a second connector. Increasing axial tension was uniformly applied to the end of the spring balance until the tubing came off the vice-mounted connector. This permitted a comparison of the force required to detach each type of tubing.

RESULTS

The tension required to remove the SMART tubing from the connector (83.3 ± 7.3 [SD] N) was significantly less than standard PVC tubing (115.6 ± 15.9 N; $p < .0001$, unpaired t test). This means that 28% less force was required to detach the new SMART tubing compared with standard PVC tubing.

DISCUSSION

While SMART tubing is reported to have important blood-handling capabilities, there has been at least one report of tubing disconnection while being used with cardiopulmonary bypass (6).

This simple experiment showed that tubing-to-connector adhesion is lower for SMART tubing. This may be of vital importance to perfusionists in terms of how extracorporeal circuits are assembled. We therefore recommend ensuring that the tubing is pushed fully onto barbed connectors and appropriately positioned, and tensioned cable ties are applied to both high- and low-pressure sections of the extracorporeal circuit.

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