LETTERS TO THE EDITOR

Thrombin generation with heparin-bonded cardiopulmonary bypass circuits

To the Editor:

We read with interest the article of Gorman and colleagues¹ on heparin-bonded circuits in the January edition of the Journal. The article addressed the fears of the surgical community with regard to the use of low systemic heparinization in patients in conjunction with heparin-bonded cardiopulmonary bypass (CPB) circuits and hence has stimulated a much needed discussion of this topic.

In our unit, we have recently completed a study using heparin-bonded circuits and reduced heparinization during simulated CPB (48 circuits in total). Heparin-bonded circuits (Carmeda BioActive Surface, Medtronic Cardiopulmonary, Anaheim, Calif.) were perfused in tandem with nonbonded circuits using the same unit of diluted fresh whole human blood at one of two levels of heparinization (3.3 U/ml and 1.1 U/ml). Inasmuch as the same blood was used in both circuits, comparisons between the circuits are paired and hence relatively powerful. The circuits were perfused for a total of 6 hours, the first 4 hours of which were at 28° C and subsequently at 37° C to mimic a rewarming period. A flow of 1 L/min was maintained throughout the perfusion period. We have analyzed the potential for thrombin generation in such a system because we believe that this is an area that merits attention.

The levels of thrombin-antithrombin complex give a good indication of the current state of activation of coagulation in a plasma sample as a result of the half-life of only 10 to 15 minutes of the thrombin-antithrombin complex. Our results show significantly higher levels of thrombin-antithrombin complex in the nonbonded circuits at 30, 60, and 120 minutes of perfusion in the low heparin experiments and in the full heparin experiments at 120 minutes. It can thus be concluded that the level of thrombin generation resulting from extracorporeal circulation is reduced by the use of the Carmeda surface. Studies with scanning electron microscopy have revealed fibrin strand formation on the nonbonded surfaces after prolonged perfusion even with full heparinization. In contrast, the heparin-bonded surfaces appeared to be free from fibrin at the same time point, indicating once again a reduction in thrombin generation with the heparin-bonded surface. We subsequently intend to perform a novel dynamic thrombin generation assay to confirm these findings. The information we have gained so far leads us to disagree with the conclusions of Gorman and associates and concurs with the commentary of Khuri, who suggested that the actual differences between the circuits may have been masked by type II errors. Furthermore, close examination of their data does show some evidence of reduced thrombin generation in the heparin-bonded circuits, which necessitates further study. We hope that the information derived from our work will add to the continuing

debate regarding heparin-bonded circuits with reduced heparinization.

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REFERENCE

1. Gorman RC, Ziats NP, Rao AK, Gikakis N, Sun L, Khan MMH, et al. Surface-bound heparin fails to reduce thrombin formation during clinical cardiopulmonary bypass. *J Thorac Cardiovasc Surg* 1996;111:1-12.

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On internal fixation for flail chest

To the Editor:

I read with great interest the report by Ahmed and Mohyuddin (*J Thorac Cardiovasc Surg* 1995;110:1676-80) of their experiences in the management of flail chest injury. Although my colleagues and I also favor internal fixation, we are unhappy with the technique that these authors have used. Pinning of fractured ribs by Kirschner wires is often technically difficult, especially when fractures involve ribs far from the one through which the chest is opened. To use Kirschner wires, one may have to open the chest very wide, thus creating yet another reason for pain. The procedure of pinning involving some degree of force at times converts partial fractures into complete ones and thus makes the chest more unstable. In elderly patients, this also sometimes shatters ribs longitudinally. Moreover, it is not a good option for long, irregular fractures. Finally, what technically appears to be a perfect job on the operating table may be a reason for prolonged nagging pain to the patient, especially when the wire pops out of the rib into the soft tissues.

Instead, we have achieved good internal fixation in 12 patients using No. 2 Vicryl thread (Ethicon, Inc., Somerville, N.J.), which can be used in more than one way to achieve the goal. It can be used to stabilize irregular, longitudinal segments by a simple over-and-over interrupted tie. Holes can be drilled into the adjoining segments of the same rib and Vicryl thread can be threaded through them for a firm tie. The fixation is easy to achieve even in distant ribs or at awkward angles without much manipulation. Our method can be used even for fractures at the curvatures of the ribs where fixation by straight wires is not possible. The technique leaves no possibility of long-term morbidity. All our patients had a stable, pain-free