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A Novel Emboli Protection Cannula During Cardiac Surgery: First Animal Study

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Objective: Stroke after open heart surgery is a major cause for morbidity and mortality. Up to 60% of intraoperative cerebral events are caused by emboli generated by manipulations of the aorta during surgery. This is the first animal study to evaluate the safety and efficacy of a novel aortic cannula designed to produce simultaneous forward flow and backward suction in order to extract solid and gaseous emboli from the distal aorta upon their release during cardiac surgery.

Methods: The research group consisted of seven domestic pigs connected to cardiopulmonary bypass using a Cardiogard 24F aortic cannula. Three pigs cannulated with a standard aortic cannula were defined as the control group. Several main flow and suction regimens were carried out. Osseous particles of different sizes were injected into the proximal aorta so as to simulate emboli. An external filter was located on the suction tube in order to evaluate the amount of solid emboli caught by the cannula. The flow inside the carotid artery, with and without the backward suction, was documented by ultrasound during injection of the particles (figure 1).

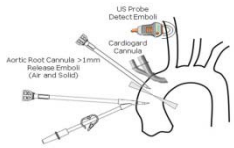

Figure 1: The experimental diagram of the research group.

Results: The Cardiogard cannula demonstrated an overall emboli retrieval rate of 77%. A rate of 88.45% was demonstrated during the low-flow regimen clinically used during aortic manipulation (figure 2). Gaseous and solid emboli were eliminated by suction, as demonstrated by epi-carotid ultrasound. No significant changes were observed in the hemodynamics and laboratory parameters for the research group (Cardiogard cannula) versus the control group

during and after surgery.

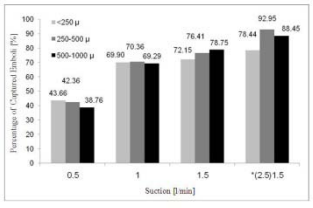

Figure 2. The emboli capturing results according to particles' sizes in the research group.
Net flow of 4 l/min was maintained during each suction values.
*Suction of 1.5 l/min and forward flow of 2.5 liter/min, simulating low flow conditions.

Conclusions: The research cannula is as simple to use as the regular aortic cannula currently commercially available, having a similar safety profile and proven efficacy in capturing intraoperative emboli in vivo.