

# OPTIFLOW™ Arterial Cannula

## Dispersive aortic cannulas reduce aortic wall shear stress affecting atherosclerotic plaque embolization

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### INTRODUCTION

- “One of the major adverse events that may occur during extracorporeal circulation (ECC) in cardiac surgery is **arterial embolization of atherosclerotic plaques resulting in stroke or ischemia of other organs** such as kidney, liver, or intestine.”
- “Besides being manually mobilized during cross-clamping of the aorta, **plaques may delaminate or rupture due to the jet stream of the aortic inlet cannula of the heart-lung machine.**”
- “Enhanced maximum wall shear stress (WSS) values have been reported to be correlated with the rupture of atherosclerotic plaques.”
- “The present study aims at examining the effects of dispersive cannula tips [Sorin Optiflow arterial cannula] on the aortic WSS profile under pulsatile and nonpulsatile ECC conditions.”
- “In order to obtain spatial and temporal WSS values for the whole human aorta, our recently validated numerical model for ECC simulations was applied.”

### MATERIALS AND METHODS

- “Geometric data were imported into the grid generator Gambit (ANSYS, Canonsburg, PA, USA) and afterward transferred into the computational fluid dynamics modeling software Fluent (ANSYS).”
- “Straight as well as bent dispersive aortic cannulas (Sorin Optiflow, Sorin, Milan, Italy) were compared with each other and with straight as well as bent standard end-hole cannulas.”
- “The insertion site was the distal ascending aorta, cannulated with a lead-in angle of 80° for the bent dispersive cannula or 90° for the bent standard cannula. The center of each cannula tip was positioned in the center of the vessel lumen. (Fig. 1)”

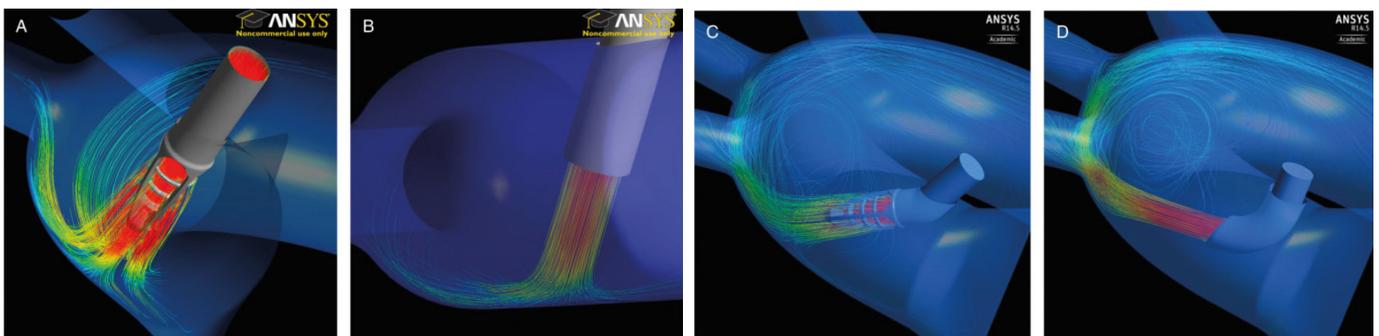


Figure 1. Cannula outlet flow profiles for different tip shapes

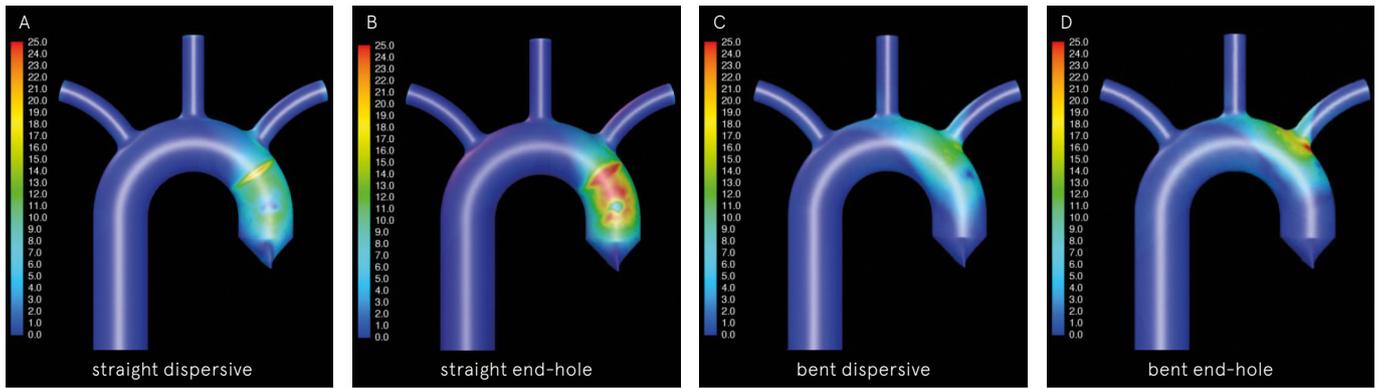


Figure 2. WSS profiles resulting from nonpulsatile perfusion. View on the posterior aortic wall opposite to the cannulation site. WSS given in pascals.

## RESULTS

- *“Dispersive cannula tips [Sorin Optiflow arterial cannula] remarkably reduced the area of enhanced WSS as compared with controls, whereas bent tips further diminished the stressed region (Fig 2).”*
- *“For bent and straight tip shapes, dispersive geometries [Sorin Optiflow arterial cannula] reduced not only the spatial extent but also the absolute amount of WSS exerted on the aortic walls. (Tab 1).”*
- *“The maximum values for nonpulsatile ECC as well as for the average and peak WSS during pulsatile ECC were diminished by approximately 50%.”*

Table 1. Maximum values of aortic WSS by shape of the aortic cannula tip

CANNULA TIP SHAPE	WSS (Pa)	
	Non pulsatile perfusion*	Pulsatile perfusion <sup>§</sup>
STRAIGHT DISPERSIVE [SORIN OPTIFLOW ARTERIAL CANNULA]	22	20/110
STRAIGHT END-HOLE	37	40/250
BENT DISPERSIVE [SORIN OPTIFLOW ARTERIAL CANNULA]	16	23/132
BENT END-HOLE	34	43/227

\* Mean values. <sup>§</sup> Mean values/peak values.

## CONCLUSIONS

- *“Based on our recently developed and validated numerical model for simulating the effect of extracorporeal circulation on human aortic blood flow, the present study shows that straight as well as bent arterial cannulas with meshlike dispersive tips [Sorin Optiflow arterial cannula] improve aortic wall shear stress and turbulence profiles.”*
- *“Moreover, this effect was observed to be independent of whether pulsatile or nonpulsatile flow was applied.”*
- *“Thus, dispersive cannulas [Sorin Optiflow arterial cannula] have the potential to reduce ECC-related complications such as stroke, endothelial damage, and hemolysis.”*

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