Geometrical analysis of embolic material produced by aortic cross-clamp manipulation of the ascending aorta.

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Objective: Aortic atherosclerosis is a well known risk factor for cerebrovascular accidents in cardiac surgery. The purpose of the present study was to analyze the geometrical distribution of particles produced by cross clamp manipulation of the ascending aorta.

Material and Methods: A model was designed with cadaver aorta and retrograde perfusion (n=27). The aorta was flushed with perfusion medium to removed debris, followed by a perfusate sample representing the baseline prior to manipulation. A standard aortic cross-clamp was positioned on the ascending aorta, similar to routine surgery. During constant pressure, the clamp was momentarily released, and a washout sample was collected in a test tube. The procedure was repeated 10 times. Washout samples were collected on glass slides and evaluated macro- and microscopically by digital image analysis. Particles were subdivided in diameter intervals from <5 µm to >2 mm. Microscopic particles were calibrated in numbers against the sample size on each glass slide. Particle data were logarithmically transformed to which two-tailed Student's t-test was applied.

Results: The model showed that aortic cross-clamping generated a substantial output of particles, and with an inverse logarithmic relationship between particle number and size (*P*<.001). The initial clamp release produced a burst of particles above the baseline (<5 µm to 0.5-1 mm intervals). A similar trend was seen for 1-2 mm particles (*P*=.054). All diameter intervals showed a reduction in particle numbers with repeated clamp maneuvers (P=.019 to P<.001). The experimental model appeared to have its greatest sensitivity in the 0.1-0.5 mm range (*P*=.001).

Conclusion: Aortic cross clamping produced particles of variable size. Macroscopic particles were few but may cause stroke. The substantial numbers of intermediate-size particles may have microembolic potential and contribute to diffuse forms of brain dysfunction after cardiac surgery.