Authors have nothing to disclose with regard to commercial support.

(third row, left to right). The symbols σ and τ are used to distinguish the normal and shear components, respectively. It can be appreciated that the normal stress terms in the stress tensor are defined as those when $i = j$. Emerel and colleagues² are comparing the $\sigma_{\theta\theta}$ (the circumferential normal, aka “hoop,” stress) with σ_{zz} (the axial normal stress), which they newly identified as relating to dissection risk.

Our literature is replete with the phrase “shear stress” with regard to the aorta. Emerel and colleagues² have offered a different, and perhaps more pertinent, perspective on aortic wall stress.

Keshava Rajagopal, MD, PhD^a
 Boyce E. Griffith, PhD^{b,c,d}
 Abe DeAnda, Jr, MD^e

^aDepartment of Advanced Cardiopulmonary Therapies and Transplantation
 McGovern Medical School
 University of Texas–Houston
 Houston, Tex

^bCarolina Center for Interdisciplinary Applied Mathematics
 University of North Carolina
 Chapel Hill, NC

^cComputational Medicine Program
 University of North Carolina
 Chapel Hill, NC

^dMcAllister Heart Institute
 University of North Carolina
 Chapel Hill, NC

^eDivision of Cardiovascular and Thoracic Surgery
 UTMB–Galveston
 Galveston, Tex

References

1. DeCampi WM. Commentary: avoiding the fate of King George II: are we making progress? *J Thorac Cardiovasc Surg*. 2019;158:364-5.
2. Emerel L, Thunes J, Kickliter T, Billaud M, Phillippi JA, Vorp DA, et al. Predissection-derived geometric and distensibility indices reveal increased peak longitudinal stress and stiffness in patients sustaining acute type A aortic dissection: implications for predicting dissection. *J Thorac Cardiovasc Surg*. 2019;158:355-63.
3. Rajagopal K, Griffith BE, DeAnda A Jr. Commentary: the mechanics of acute aortic dissection: measured calculations and calculated measures. *J Thorac Cardiovasc Surg*. 2019;158:366-7.
4. Truesdell CA, Rajagopal KR. *An introduction to the mechanics of fluids* (Modern Birkhäuser Classics). Basel: Birkhäuser Verlag; 2000.

<https://doi.org/10.1016/j.jtcvs.2019.10.075>

REPLY FROM THE AUTHOR: WALL STRESS, WALL SHEAR STRESS, TENSILE STRESS, NORMAL STRESS,

LONGITUDINAL STRESS, ETC

Reply to the Editor:

Agnosco fateor! (“I admit I was wrong,” as Guillaume Budé wrote to Erasmus.¹) Gleason’s letter is correct—I mistook the designation of “wall stress” (the expression used by Emerel and colleagues² in their original article) to mean “wall shear stress.” As such, in the description of their principal findings in my Commentary,³ readers should replace the expression “wall shear stress” or “WSS” with “wall stress.”

Figure 1 shows all the possible stresses acting on an element of a solid body. There are 9 of them! Mathematically, they form a second-order tensor—a generalization of the force vector in simple mechanics. It is important to keep track of them, preferably with standard nomenclature in a given application.

The distinction among them is important. In the context used by the Emerel and colleagues,² “wall stress” is the stress that tends to distend the aorta when the lumen is pressurized with blood. The pressure, or force per unit area, acts perpendicular to the wall. Think of the Laplace law. Wall shear stress, on the other hand, is the force per unit area exerted on the wall (and parallel to it) by flowing blood. This force is like friction and arises from the viscosity of blood. As Gleason states in his letter, both stresses may play a role in producing aortic pathology. Excess “pressure” stress may act directly on the integrity of the connective tissues comprising the wall. Inappropriate wall shear stress may affect the integrity and signaling of

FIGURE 1. Mechanical stress is not a scalar or a vector. It is a tensor with 9 components.

Author has nothing to disclose with regard to commercial support.

endothelial cells, with secondary effects on aortic wall remodeling.

Fortunately, my Commentary description of the role that wall *shear* stress may play in aortopathy and dissection remains relevant. Consider the Commentary, therefore, to complement, as well as compliment, the work of Emerel and colleagues.²

William M. DeCampi, MD, PhD
Department of Clinical Sciences
University of Central Florida College of Medicine

Orlando, Fla
Division of Pediatric Cardiothoracic Surgery
Arnold Palmer Hospital for Children
Orlando, Fla

References

1. Lerer S. *Error and the Academic Self: The Scholarly Imagination, Medieval to Modern*. New York: Columbia University Press; 2002:3.
2. Emerel L, Thunes J, Kickliter T, Billaud M, Phillippi JA, Vorp DA, et al. Predissection-derived geometric and distensibility indices reveal increased peak longitudinal stress and stiffness in patients sustaining acute type A aortic dissection: implications for predicting dissection. *J Thorac Cardiovasc Surg*. 2019;158:355-63.
3. DeCampi WM. Commentary: avoiding the fate of King George II: are we making progress? *J Thorac Cardiovasc Surg*. 2019;158:364-5.

<https://doi.org/10.1016/j.jtcvs.2019.10.079>