Stroke
JOURNAL OF THE AMERICAN HEART ASSOCIATION
American Stroke Association
A Division of American Heart Association

Clarification of *abc*/2 Rule for ICH Volume

George C. Newman

Stroke 2007, 38:862: originally published online January 25, 2007
doi: 10.1161/01.STR.0000257309.50643.0a
Stroke is published by the American Heart Association. 7272 Greenville Avenue, Dallas, TX 72514
Copyright © 2007 American Heart Association. All rights reserved. Print ISSN: 0039-2499. Online ISSN: 1524-4628

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://stroke.ahajournals.org/content/38/3/862

Subscriptions: Information about subscribing to Stroke is online at
http://stroke.ahajournals.org//subscriptions/

Permissions: Permissions & Rights Desk, Lippincott Williams & Wilkins, a division of Wolters Kluwer Health, 351 West Camden Street, Baltimore, MD 21202-2436. Phone: 410-528-4050. Fax: 410-528-8550. E-mail:
journalpermissions@lww.com

Reprints: Information about reprints can be found online at
http://www.lww.com/reprints

Downloaded from http://stroke.ahajournals.org/ by guest on May 3, 2012

Letters to the Editor

Stroke *welcomes Letters to the Editor and will publish them, if suitable, as space permits. They should not exceed 750 words (including references) and may be subject to editing or abridgment. Please submit letters in duplicate, typed double-spaced. Include a fax number for the corresponding author and a completed copyright transfer agreement form (published in every issue).*

Clarification of *abc*/2 Rule for ICH Volume

To the Editor:

There appears to be a common misperception that the denominator of 2 in the ICH calculation for $Volume = abc/2$ is attributable to use of 5-mm slices in CT. This is not the case.

Calculating $Volume = abc/2$ is based on the assumption that the ICH volume can be approximated by an ellipsoid. This is a good assumption as long as the hemorrhage is not multilobulated or otherwise very irregular in shape.

An ellipsoid can be described in Cartesian coordinates using its 3 perpendicular axes, commonly identified on CT or MRI as the largest cross-sectional diameter (a), a second diameter drawn at right angles to the first (b) and the height of the ellipsoid (c), estimated from the number and thickness of slices in which the hemorrhage is visible. This last element has the potential to introduce confusion, however.

The Cartesian approximation of the formula for an ellipse can be written as:

$$Volume = \frac{4}{3}\,\pi\, x\, y\, z$$

where x, y and z are the semi-axes, that is *half* of the axes defined above. Expressly introducing the measured full-width axes for the semi-axes into this formula yields:

$$Volume = \frac{4}{3}\pi\frac{a}{2}\times\frac{b}{2}\times\frac{c}{2}$$

Note that in this general expression, c is expressed in the same units as the other axes. The number or thickness of slices on CT has not yet been considered. Using the approximation that $\pi \approx 3$, the equation simplifies to:

$$Volume = \frac{a\times b\times c}{2}$$

Thus, the factor of 2 is necessary to calculate the volume of an ICH ellipsoid using Cartesian coordinates. The length of c should be calculated in centimeters, using the number of slices and slice thickness, before entering the value of c into the equation. (That is, even if the CT slices were 1 cm thick, division by 2 would still be necessary for calculating volume.) In retrospect, this division by 2 is intuitively logical because otherwise application of the rule would be tantamount to calculating $height \times width \times length$, which is the volume of a rectangular cube, and would clearly overestimate the volume of an ellipsoid which fits within that cube.

ICH volume is an essential factor for offering prognosis and planning management. Therefore, it is important that the basis of this factor of 2 be clearly recognized to avoid incorrectly doubling estimates of lesion volume.

George C. Newman, MD, PhD
Department of Neurosensory Sciences
Albert Einstein Medical Center
Philadelphia, Pa

(*Stroke.* **2007;38:862.**)
© 2007 American Heart Association, Inc.
Stroke **is available at http://www.strokeaha.org** **DOI: 10.1161/01.STR.0000257309.50643.0a**

Downloaded from http://stroke.ahajournals.org/ by guest on May 3, 2012