Commentary: Will the circle be unbroken?

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Central Message

Unilateral antegrade cerebral perfusion for cerebral protection is probably safe unless ischemic times are expected to exceed 50 minutes.

See Article page 2159.

In the hymn “Will the Circle Be Unbroken,” written in 1907 by Ada R. Habershon,¹ the central tenet is that the legacy, knowledge, and lessons learned by those who have gone before us will be passed to those left behind. Such data transfer has enabled those who remain to maintain a connection, a circle, with those who have died, not to mention that the hymn has remained a go-to ritual everywhere from worship services to family memorials, gospel sings, bluegrass picking parties, Americana award show finales, and the annual Country Music Hall of Fame induction ceremony. Such a circle of stability and connectivity can be demonstrated anatomically as well, with even greater implications. Thomas Willis (1621-1675), considered one of the greatest neuroanatomists of all time, wrote *Cerebri Anatome (Cerebri Anatome Neroorumgue Descriptio el Usus—The Anatomy of the Brain and Nerves)* in 1664 while Professor of Natural Philosophy at Oxford. This work included Willis’s classification of the cranial nerves and his description of the arterial pattern at the base of the brain widely known as the circle of Willis.²

The circle of Willis, an arterial ring at the base of the brain in the interpeduncular fossa, is formed by the anastomosis between the 2 internal carotid arteries and the 2 vertebral arteries, with contributions from the anterior communicating, anterior cerebral, internal carotid, posterior communicating, posterior cerebral, and basilar arteries. Cerebral cross-perfusion through an intact arterial arcade is thought to be essential for ipsilateral brain viability, particularly during unilateral cerebral insult or cardiac surgical procedures that rely on such arterial relationships during antegrade cerebral perfusion for complex thoracic aortic reconstruction. Questions regarding perfusion strategies for cerebral preservation, specifically unilateral or bilateral antegrade cerebral perfusion, become more vexing given the known incompleteness and variability of the circle of Willis in 17% to 40% of brains examined by anatomic or angiographic studies.³⁻⁵

The article by Angleitner and colleagues⁶ published in this month’s *Journal* represents another publication that

seeks to address the fundamental issue of appropriate cerebral protection by unilateral or bilateral cerebral perfusion during cardiac surgical repair of acute type A aortic dissection. Although the results of this single-center analysis are significantly limited by the small sample size and the expertise of an experienced aortic team operating on only 31.5% of cases, the results conclude that bilateral antegrade cerebral perfusion “is associated with significantly improved overall survival in patients requiring antegrade cerebral perfusion durations ≥ 50 min.”⁶ Their results support the findings of improved mortality rates in literature reviews⁷ and meta-analyses in patients treated with bilateral antegrade perfusion when circulatory arrest times are longer than 30 to 40 minutes.⁸ Such strategy is incomplete, however, unless moderate hypothermia (24°C-28°C) is used, perfusion flows are maintained at 6 to 10 mL/kg/min with pressures of 40 to 60 mm Hg,⁷ and monitoring of regional cerebral oxygen saturation with near-infrared spectroscopy is considered.⁹

Until adequately powered, prospective, randomized, controlled trials are performed to address this issue more accurately, it remains to be seen whether the “circle” can be “broken” or incomplete, and perfused only unilaterally without deleterious results in mortality and morbidity. Judicious use of unilateral antegrade cerebral perfusion with a permissive and aggressive default to bilateral perfusion with the expectation of longer cardiac arrest times, or if there are declines in regional cerebral

oxygen saturation, may allow more consistent clinical results.

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