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Rebuttal from Ryan L. Hoiland and Philip N. Ainslie

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Brothers & Zhang (2016) provide a relevant CrossTalk discussion on the measurement of middle cerebral artery (MCA) diameter during alterations in arterial blood pressure (ABP) and gases. While in support of a constant MCA diameter, they nonetheless judiciously acknowledge that several previous studies indicating a constant MCA diameter, specifically during alterations in arterial blood gases, are confounded by subject co-morbidities, anesthesia, and/or suffer from poor resolution (1.5 T MRI) (Schreiber *et al.* 2000; Serrador *et al.* 2000). They speculate that elevations in ABP and the associated autoregulatory response concurrent to hypercapnia may explain the increases in diameter reported by the more recent and higher resolution MRI studies (3 and 7 T) assessing MCA diameter (Verbree *et al.* 2014; Coverdale *et al.* 2014). The rationale for this hypothesis is unclear as the available data in humans indicate an increase in ABP will increase cerebral vascular resistance in large cerebral arteries (Liu *et al.* 2013; Warnert *et al.* 2016). Collectively, these findings indicate that any engagement of autoregulatory mechanisms would more likely lead to an underestimation of vasodilatation, not overestimation.

In their discussion of arterial blood gases, Brothers & Zhang fail to discuss the potential for hypoxia-induced vasomotion of the MCA. Previous study has indicated MCA dilatation in hypoxia (Wilson *et al.* 2011), in addition to more recent evidence that continues to highlight a tendency for increased MCA diameter (Sagoo *et al.* 2016). Overall there is a strong body of data supporting hypoxia-induced dilatation at the level of the MCA.

It is noted by Brothers & Zhang that the study by Serrador *et al.* (2000) provides insight into MCA diameter during mild hypotension; however, a statistical change in BP did not occur during their simulated orthostasis trial (see Table 2 in Serrador *et al.* 2000). This renders the study by Giller *et al.* (1993) the only one to date that has directly imaged MCA diameter during alterations in ABP. Thus, while it remains difficult to definitively conclude the effect of ABP on MCA diameter, a large body of evidence now supports the notion that MCA diameter does change during alterations in arterial blood gases. Although we acknowledge that much utility still exists in the employment of transcranial Doppler ultrasound, we encourage the complimentary addition of multi-modal imaging to provide important new insight into cerebrovascular regulation in humans.

Call for comments

Readers are invited to give their views on this and the accompanying CrossTalk articles in this issue by submitting a brief (250 word) comment. Comments may be submitted up to 6 weeks after publication of the article, at which point the discussion will close and the CrossTalk authors will be invited to submit a 'Last Word'. Please email your comment, including a title and a declaration of interest, to jphysiol@physoc.org. Comments will be moderated and accepted comments will be published online only as 'supporting information' to the original debate articles once discussion has closed.

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Additional information

Competing interests

The authors declare no conflict of interest, financial or otherwise.

Author contributions

Both authors have approved the final version of the manuscript and agree to be accountable for all aspects of the work. All persons designated as authors qualify for authorship, and all those who qualify for authorship are listed.

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