

Joint position statement by the Councils of the Neuroanaesthesia and Critical Care Society of Great Britain and Ireland (NACCS) and the Society of British Neurological Surgeons (SBNS) with regards to the calculation of cerebral perfusion pressure in the management of traumatic brain injury.

Position Statement

NACCS and SBNS recommend that in the management of traumatic brain injury, when calculating cerebral perfusion pressure (CPP), the arterial transducer used to estimate mean arterial pressure (MAP) for the calculation $CPP = MAP - ICP$ should be positioned at the level of the tragus.

Rationale

The councils of NACCS and SBNS acknowledge that there has been recent controversy regarding the evidence base for the measurement of intracranial pressure (ICP) and cerebral perfusion pressure (CPP) and that questions regarding ICP and CPP directed management remain unanswered. However, currently, monitoring and management of ICP and CPP based on the Brain Trauma Foundation Guidelines remains a standard of care following traumatic brain injury (TBI). This has recently been reviewed by Kirkman and Smith in the *Br J Anaesth* 2014;112:35-46 and previously in an editorial by Kosty and Kofke in *J Neurosurg Anaesthesiol* 2012;24:1-2.

The calculation of CPP is an integral part of this strategy, as described by Rosner and colleagues in their seminal paper in *J Neurosurg* 1995;83:949-962. In this article the MAP used was measured in supine patients at the level of the middle cranial fossa to estimate trans-cranial perfusion described by the equation:

$$CPP = MAP - ICP$$

In 2013 Subhas, Wilson and Jain conducted a national survey of cerebral perfusion pressure measurement practices in Great Britain and Ireland. Their results were presented at the NACCS meeting in Cardiff and the abstract published in the *Journal of Neurosurgical Anaesthesiology (J Neurosurg Anaesthesiol* 2013;25:362). They revealed that, in calculating CPP, 58% of Neurosurgical ICUs place the arterial transducer at the level of the heart and 42% place it at the level of the tragus. No-one routinely nursed their patients in the supine position and 84% nursed patients 30 degrees head up. They also demonstrated that 94% of respondents wished NACCS to endorse a consensus statement on standardisation of CPP measurement practices in Great Britain and Ireland.

This has been considered by the Councils of NACCS and SBNS who wish to make the following joint statements:

Research involving CPP calculation or CPP derived variables

Councils of NACCS and SBNS recommend that all research articles relating to CPP measurement or CPP derived variables in the management of TBI should explicitly state in their methodology as to where the arterial transducer was positioned (levelled) for relevant measurements.

Councils endorse positioning (levelling) the arterial transducer at the level of the middle cranial fossa which can be approximated to the tragus of the ear.

Clinical practice involving CPP based targets and management based on recommendations by the Brain Trauma Foundation

Whilst not wishing to dictate local clinical practice, based on the available evidence, the Councils of NACCS and SBNS would recommend that when calculating CPP in traumatic brain injury the MAP used in the equation $CPP = MAP - ICP$ should be the mean cerebral arterial pressure estimated to exist at the level of the middle cranial fossa, which can be approximated by positioning (levelling) the arterial transducer at the tragus of the ear.

They also recommend that the arterial transducer is re-positioned to remain levelled with the tragus following changes in body elevation / position.

Councils do not endorse positioning (levelling) the arterial transducer at heart level (phlebostatic axis) for CPP based treatment decisions as there is a requirement for subsequent cerebral mean arterial pressure (MAP) to be calculated which is dependent on the relationship:

$$MAP_{\text{brain}} = MAP_{\text{heart}} - (\text{water column between heart and brain} \times C)$$

where C is a coefficient, always lower than 1, dependent on conditions of both the arterial and venous elements of the cerebral circulation which is not reliably predictable and is variable between individuals.

For centres that wish to continue to position (level) their arterial transducers at that of the heart for CPP based TBI management they should have explicit guidance within their TBI protocols on how they take account of this difference and its subsequent effect on individual CPP calculation for patient management.

NACCS and SBNS

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