Reported practice of temperature adjustment (α-stat v pH-stat) for arterial blood gases measurement among investigators from two major cardiac arrest trials

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Arterial blood gases (ABGs) are routinely measured in resuscitated patients with out-of-hospital cardiac arrest admitted to the intensive care unit (ICU) to guide treatment.[1] ABG tension is affected by temperature. When temperature falls, pH increases and both the arterial partial pressure of oxygen (Pao_2) and the arterial partial pressure of carbon dioxide ($Paco_2$) decrease.[2] Conversely, when temperature rises, pH decreases and both Pao_2 and $Paco_2$ increase.[2] As resuscitated patients with cardiac arrest are commonly treated with a variety of targeted temperature management strategies (33–37°C)[3], clinicians have the choice to assess ABGs after adjustment to 37°C (α-stat) or without adjustment (pH-stat), with ABG measured at actual body temperature.[4-7] Targeted Therapeutic Mild Hypercapnia after Resuscitated Cardiac Arrest (TAME) (ClinicalTrials.gov identifier: NCT03114033) and Targeted Hypothermia versus Targeted Normothermia after Out-of-hospital Cardiac Arrest (TTM2) (NCT02908308) are two harmonised global cardiac arrest trials. These trials are evaluating potentially different strategies that aim to mitigate neurological injury after cardiac arrest. While the TTM2 study will determine the optimal temperature strategy (33°C v 37°C), the TAME trial will compare targeted mild hypercapnia versus targeted normocapnia. However, the TAME trial will allow clinicians to either choose their usual temperature strategy or to co-enrol with TTM2 (ie, 33°C or avoiding fever ≤ 37.8°C). The trials have agreed to standardise ABG using the α-stat method. However, the current approach and practice of ABG analysis at TAME and TTM2 trial sites remain unknown, and it is important to establish current attitudes to such an approach among investigators.

Methods

With ethics approval (Austin Health Human Research Ethics Committee approval no. 29052), we conducted an online anonymous multichoice questionnaire to describe the TAME and TTM2 site investigators' self-reported practice of ABG analysis for resuscitated patients with cardiac arrest.

ABSTRACT

Background: Two major cardiac arrest trials are evaluating different strategies that may potentially mitigate neurological injury after cardiac arrest and are allowing co-enrolment. However, one trial will target hypothermia and the other will target mild hypercapnia, in which the carbon dioxide (CO_2) measurement may be influenced by the choice of temperature adjustment during arterial blood gases (ABGs) measurement. The trials have agreed to standardise assessment by the α-stat method.

Objectives: To describe the Targeted Therapeutic Mild Hypercapnia after Resuscitated Cardiac Arrest (TAME) and Targeted Hypothermia versus Targeted Normothermia after Out-of-hospital Cardiac Arrest (TTM2) site investigators' self-reported practice of ABG analysis and, in particular, their view of whether α-stat or pH-stat assessment of ABGs is considered optimal.
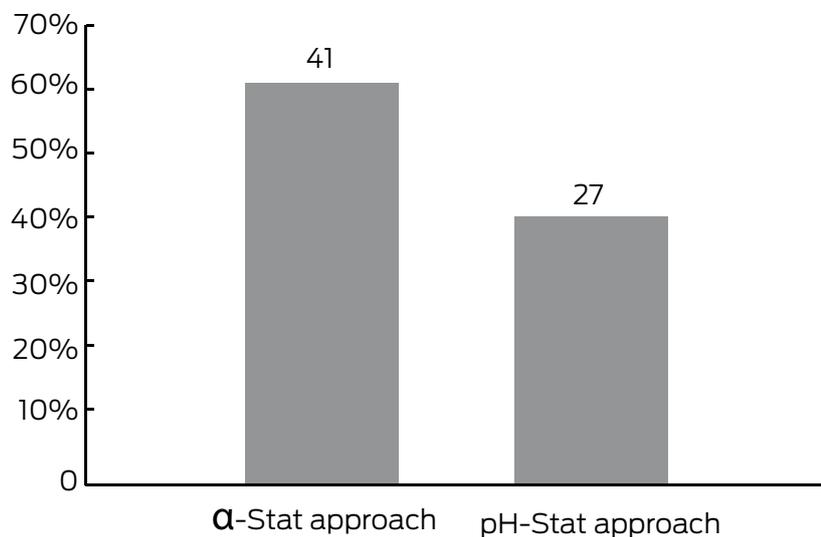
Methods: We performed an online anonymous multichoice survey. Of the 136 site investigators emailed, 70 (51%) responded. Of these, 19 (27%) were participating in the TAME trial only, 22 (31%) were in TTM2 only, and 29 (41%) were participating in both.

Results: The majority of respondents identified α-stat (41/68, 60%) compared with pH-stat (27/68, 40%) as their usual approach to ABG analysis when targeting 33°C. In addition, the proportion and pattern of concern over hyperventilation was similarly reported as either "not concerned" or "neutral" when using an α-stat (46/69, 66%) or pH-stat (50/68, 73%) ABG analysis approach. Finally, for the purpose of a randomised controlled trial, most respondents either "strongly agreed", "agreed" or "neither agreed nor disagreed" to use the α-stat (59/69, 85%) or the pH-stat (61/70, 87%) approach.

Conclusion: Our survey findings support the acceptability of the decision to apply the α-stat approach across participating sites for both trials.

Figure 1. Reported usual practice for arterial blood gas analysis if targeting 33°C for resuscitated patients with cardiac arrest (*n* = 68)

Responses were collected between 14 September and 15 October 2018 with the SurveyMonkey platform (www.surveymonkey.com) (online Appendix, available at cicm.org.au/Resources/Publications/Journal). We applied descriptive statistics to the analysis of our findings.

Results

We invited 136 site investigators, of whom 70 (51%) responded. The investigators were from 17 different countries, with the highest number of respondents in Australia, Italy and the United Kingdom (online Appendix).

Figure 2. Level of concern over hyperventilation when using the α-stat approach to arterial blood gas analysis (*n* = 69)

Of these, 19 (27%) were "TAME only", 22 (31%) were "TTM2 only", and 29 (41%) were participating in both TAME and TTM2 trials. Most respondents practised in a university hospital. The majority of respondents estimated that between 21 and 60 patients with out-of-hospital cardiac arrest were admitted to their ICUs each year. The estimated desirable frequency of ABG measurement was reported as every 4 hours over the first 48 hours, and targeted temperature management use was applied to between 76% and 100% of cardiac arrest admissions (online Appendix).

A majority of respondents identified α-stat (41/68, 60%) compared with pH-stat (27/68, 40%) as their usual approach to ABG analysis when targeting 33°C (Figure 1). In addition, the proportion and pattern of concern over hyperventilation was similarly reported as either "not concerned" or "neutral" when using an α-stat (46/69, 66%) (Figure 2) or pH-stat (50/68, 73%) (Figure 3). Finally, for the purposes of a randomised controlled trial, most respondents either "strongly agreed", "agreed" or "neither agreed nor disagreed" to use the α-stat (59/69, 85%) or pH-stat (61/70, 87%) approach to ABG analysis.

Discussion

Our survey of participants in the TTM2 and/or TAME trials found that when targeting 33°C, respondents preferred the α-stat approach to ABG analysis, with limited concern about the risk of hyperventilation, and that, for the purposes of a clinical trial, they had a similar level of agreement for either the α-stat or pH-stat approach.

Currently, both TAME and TTM2 trial protocols stipulate the use of the α-stat approach to ABG analysis. In the absence of multicentre randomised clinical trials focusing on the definitive approach to ABG analysis for resuscitated patients with cardiac arrest,[4,6] our survey findings support the decision to standardise ABG assessment to the α-stat approach and the view
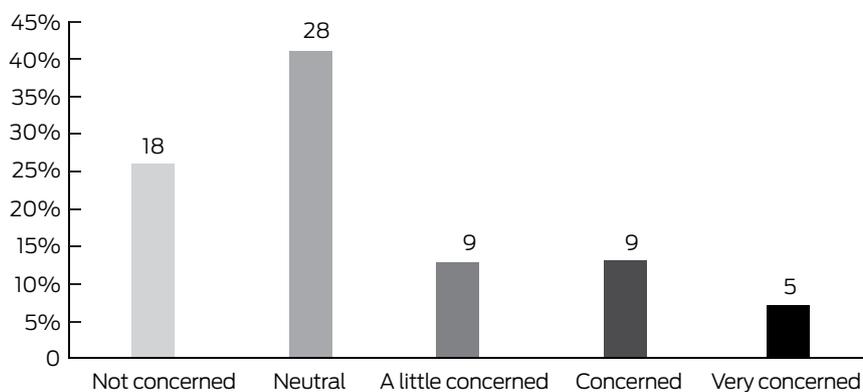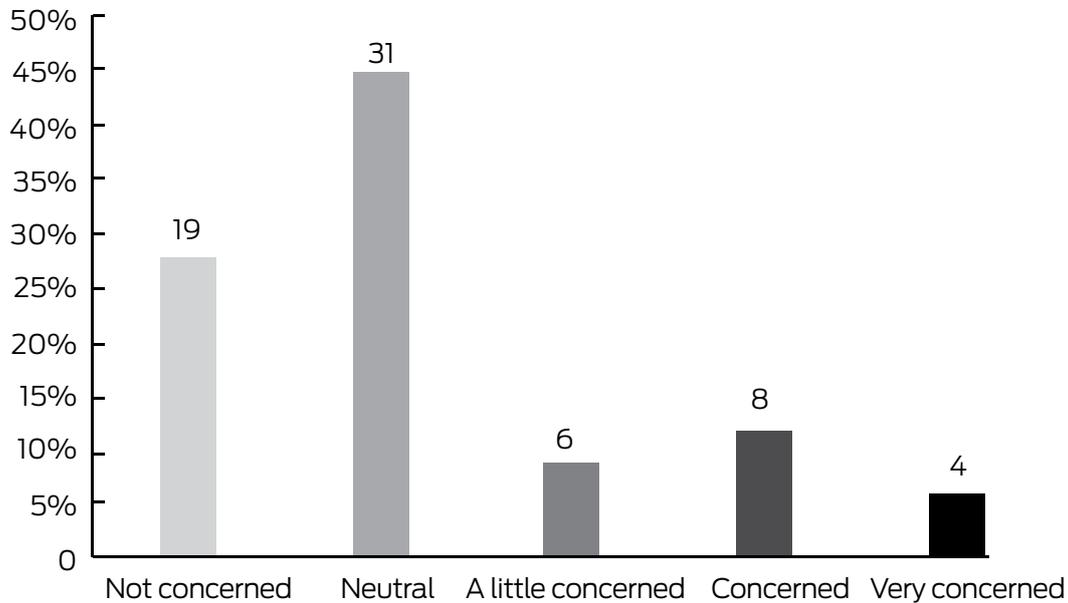
Figure 3. Level of concern over hyperventilation when using the pH-stat approach to arterial blood gas analysis (*n* = 68)

that such practice represents acceptable practice in the participating centres at the start of the two trials.

Competing interests

None declared.

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