A look at recent hyperventilation studies: outcomes and recommendations for early use in the head-injured patient

Geraci E, Geraci T

Authors' objectives
To determine if outcomes for the head-injured patient continued to support the use of hyperventilation in the pre-hospital and early hospital phase of care, and if current investigators still recommend hyperventilation for all unconscious, head-injured patients.

Searching
MEDLINE was searched from 1984 to 1994.

Study selection

Study designs of evaluations included in the review
Descriptive case studies, quasi-experimental studies and randomised controlled trials (RCTs) were included.

Specific interventions included in the review
Hyperventilation or the reduction of carbon dioxide, either alone or as part of the total management of the severely head-injured patient. Hyperventilation or suction procedure cycle. Tromethamine and hyperventilation versus hyperventilation alone versus normal ventilation.

Participants included in the review
Head-injured patients, ranging from 2T to 12 on the Glasgow Coma Scale and aged 1 month upwards. Variable pathology including trauma, asphyxia, stroke, meningitis, intracerebral haematoma, subarachnoid haemorrhage and acute subdural haematoma.

Outcomes assessed in the review
Arterial venous oxygen difference, cerebral blood flow, global cerebral oxygenation, perfusion pressure, expired carbon dioxide, cerebral blood flow, arterial carbon dioxide, arterial and jugular bulb oxyhaemoglobin saturation, and lactate levels. Dementia, vegetative survival and death. Cerebral vascular reactivity assessed using xenon-enhanced computed tomography. Jugular venous oxygen saturation.

How were decisions on the relevance of primary studies made?
The authors do not state how the papers were selected for the review, or how many of the authors performed the selection.

Assessment of study quality
The authors do not report the method used to assess quality, or how the quality assessment was performed.

Data extraction
The authors do not state how the data were extracted for the review, or how many of the authors performed the data extraction.

Methods of synthesis
How were the studies combined?
The studies were combined qualitatively by a narrative description.

How were differences between studies investigated?
The authors do not state how differences between the studies were investigated.

**Results of the review**

Five descriptive case studies (N=235), 6 quasi-experimental studies (N=245) and 1 RCT (N=113) were included.

Hyperventilation in each study was associated with ischaemia, secondary brain injury and adverse patient outcomes. Early use of hyperventilation (especially under 24 hours) was an area of particular concern.

**Authors’ conclusions**

Findings suggest that head-injured patients in the pre-hospital and early phases of care are at increased risk of suffering hyperventilation-induced secondary brain injury, and that a cautious, highly monitored and selective approach to hyperventilation be adopted.

**CRD commentary**

The literature search was limited to one database. Only one RCT is included in the review. A more extensive search may have revealed more controlled trials of the effects of hyperventilation on head-injured patients and included more studies with longer-term outcome measures. The authors comment that there is no detailed description of the hyperventilation techniques used in the primary studies, or of the great variability in patient injury patterns and temporal measurements. In addition, there is a lack of detail of the methodology, and a minimal evaluation of the quality of the included studies: in particular, several studies reporting changes in various measures in patients who have been hyperventilated lack reports on the same measures of controls who were not hyperventilated; some outcomes are inadequately defined, e.g. ‘poor outcomes’ and ‘worse’; and several studies lack details of the age range, pathology of participants, and hyperventilation regime. Contacting the authors of the primary studies may have resulted in further details being made available of the studies and longer-term outcome measures of the patients.

In view of the reported current practice of hyperventilation of head-injured patients, it would have been helpful to include an evaluation of the evidence for this practice in studies earlier than those included in this review.

**Implications of the review for practice and research**

Assessment of all the evidence on hyperventilation for head-injured patients should be critically evaluated. Until this evaluation is complete, any head-injured patient undergoing hyperventilation should be intensively monitored.

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Record Status
This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.