

Cochrane Database of Systematic Reviews

Processed electroencephalogram and evoked potential techniques for amelioration of postoperative delirium and cognitive dysfunction following non-cardiac and non-neurosurgical procedures in adults (Review)

Punjasawadwong Y, Chau-in W, Laopaiboon M, Punjasawadwong S, Pin-on P

Punjasawadwong Y, Chau-in W, Laopaiboon M, Punjasawadwong S, Pin-on P. Processed electroencephalogram and evoked potential techniques for amelioration of postoperative delirium and cognitive dysfunction following non-cardiac and non-neurosurgical procedures in adults. *Cochrane Database of Systematic Reviews* 2018, Issue 5. Art. No.: CD011283. DOI: 10.1002/14651858.CD011283.pub2.

www.cochranelibrary.com

Processed electroencephalogram and evoked potential techniques for amelioration of postoperative delirium and cognitive dysfunction following non-cardiac and non-neurosurgical procedures in adults (Review) Copyright © 2018 The Cochrane Collaboration. Published by John Wiley & Sons, Ltd.

WILEY



Trusted evidence. Informed decisions. Better health.

[Intervention Review]

1

## Processed electroencephalogram and evoked potential techniques for amelioration of postoperative delirium and cognitive dysfunction following non-cardiac and non-neurosurgical procedures in adults

Yodying Punjasawadwong<sup>1</sup>, Waraporn Chau-in<sup>2</sup>, Malinee Laopaiboon<sup>3</sup>, Sirivimol Punjasawadwong<sup>4</sup>, Pathomporn Pin-on<sup>4</sup>

<sup>1</sup>Department of Anesthesiology, Faculty of Medicine, Chiang Mai University, Chiang Mai, Thailand. <sup>2</sup>Department of Anesthesiology, Faculty of Medicine, Khon Kaen University, Khon Kaen, Thailand. <sup>3</sup>Department of Epidemiology and Biostatistics, Faculty of Public Health, Khon Kaen University, Khon Kaen, Thailand. <sup>4</sup>Department of Anesthesiology, Faculty of Medicine, Chiang Mai University, Chiang Mai, Thailand

**Contact:** Yodying Punjasawadwong, Department of Anesthesiology, Faculty of Medicine, Chiang Mai University, Chiang Mai, 50200, Thailand. ypunjasa@gmail.com.

**Editorial group:** Cochrane Anaesthesia Group. **Publication status and date:** Edited (no change to conclusions), published in Issue 10, 2018.

**Citation:** Punjasawadwong Y, Chau-in W, Laopaiboon M, Punjasawadwong S, Pin-on P. Processed electroencephalogram and evoked potential techniques for amelioration of postoperative delirium and cognitive dysfunction following non-cardiac and non-neurosurgical procedures in adults. *Cochrane Database of Systematic Reviews* 2018, Issue 5. Art. No.: CD011283. DOI: 10.1002/14651858.CD011283.pub2.

Copyright © 2018 The Cochrane Collaboration. Published by John Wiley & Sons, Ltd.

## ABSTRACT

## Background

Postoperative delirium (POD) and postoperative cognitive dysfunction (POCD) may complicate a patient's postoperative recovery in several ways. Monitoring of processed electroencephalogram (EEG) or evoked potential (EP) indices may prevent or minimize POD and POCD, probably through optimization of anaesthetic doses.

## Objectives

To assess whether the use of processed EEG or auditory evoked potential (AEP) indices (bispectral index (BIS), narcotrend index, cerebral state index, state entropy and response entropy, patient state index, index of consciousness, A-line autoregressive index, and auditory evoked potentials (AEP index)) as guides to anaesthetic delivery can reduce the risk of POD and POCD in non-cardiac surgical or non-neurosurgical adult patients undergoing general anaesthesia compared with standard practice where only clinical signs are used.

## Search methods

We searched CENTRAL, MEDLINE, Embase and clinical trial registry databases up to 28 March 2017. We updated this search in February 2018, but these results have not been incorporated in the review.

## **Selection criteria**

We included randomized or quasi-randomized controlled trials comparing any method of processed EEG or evoked potential techniques (entropy, BIS, AEP etc.) against a control group where clinical signs were used to guide doses of anaesthetics in adults aged 18 years or over undergoing general anaesthesia for non-cardiac or non-neurosurgical elective operations.

## Data collection and analysis

We used the standard methodological procedures expected by Cochrane. Our primary outcomes were: occurrence of POD; and occurrence of POCD. Secondary outcomes included: all-cause mortality; any postoperative complications; and postoperative length of stay. We used GRADE to assess the quality of evidence for each outcome.

Processed electroencephalogram and evoked potential techniques for amelioration of postoperative delirium and cognitive dysfunction following non-cardiac and non-neurosurgical procedures in adults (Review) Copyright © 2018 The Cochrane Collaboration. Published by John Wiley & Sons, Ltd.



Trusted evidence. Informed decisions. Better health.

#### **Main results**

We included six randomized controlled trials (RCTs) with 2929 participants comparing processed EEG or EP indices-guided anaesthesia with clinical signs-guided anaesthesia. There are five ongoing studies and one study awaiting classification.

Anaesthesia administration guided by the indices from a processed EEG (bispectral index) probably reduces the risk of POD within seven days after surgery with risk ratio (RR) of 0.71 (95% CI 0.59 to 0.85; number needed to treat for an additional beneficial outcome (NNTB) of 17, 95% CI 11 to 34; 2197 participants; 3 RCTs; moderate quality of evidence). Three trials also showed the lower rate of POCD at 12 weeks after surgery (RR 0.71, 95% CI 0.53 to 0.96; NNTB 38, 95% CI 21 to 289; 2051 participants; moderate-quality evidence), but it is uncertain whether processed EEG indices reduce POCD at one week (RR 0.84, 95% CI 0.69 to 1.02; 3 trials; 1989 participants; moderate-quality evidence), and at 52 weeks (RR 0.30, 95% CI 0.05 to 1.80; 1 trial; 59 participants; very low quality of evidence). There may be little or no effect on all-cause mortality (RR 1.01, 95% CI 0.62 to 1.64; 1 trial; 1155 participants; low-quality evidence). One trial suggested a lower risk of any postoperative complications with processed EEG (RR 0.51, 95% CI 0.37 to 0.71; 902 participants, moderate-quality evidence). There may be little or no effect on reduced postoperative length of stay (mean difference –0.2 days, 95% CI –2.02 to 1.62; 1155 participants; low-quality evidence).

### **Authors' conclusions**

There is moderate-quality evidence that optimized anaesthesia guided by processed EEG indices could reduce the risk of postoperative delirium in patients aged 60 years or over undergoing non-cardiac surgical and non-neurosurgical procedures. We found moderate-quality evidence that postoperative cognitive dysfunction at three months could be reduced in these patients. The effect on POCD at one week and over one year after surgery is uncertain. There are no data available for patients under 60 years. Further blinded randomized controlled trials are needed to elucidate strategies for the amelioration of postoperative delirium and postoperative cognitive dysfunction, and their consequences such as dementia (including Alzheimer's disease (AD)) in both non-elderly (below 60 years) and elderly (60 years or over) adult patients. The one study awaiting classification and five ongoing studies may alter the conclusions of the review once assessed.

## PLAIN LANGUAGE SUMMARY

# Optimized anaesthesia depth guided by brain electrical activity for protection against postoperative delirium and cognitive dysfunction in adults

#### **Review question**

We wanted to discover whether using brain electrical activity monitoring to guide doses of anaesthetics can reduce the risk of postoperative delirium (POD) and cognitive dysfunction (POCD) in adults undergoing general anaesthesia for non-cardiac and non-neurological surgical procedures.

#### Background

Postoperative delirium (POD) is a disturbed state of mind which occurs a few days after surgery. POD involves a fluctuating course of confusion and disorganized behaviour. Postoperative cognitive dysfunction (POCD) is a decline in the ability of a person to think clearly after an operation. This may persist for weeks or months. POCD can affect a person's concentration, attention, memory, learning, and the speed of their movement and mental responses. POD and POCD can complicate the quality of a person's recovery from anaesthesia, as well as the quality of their life after surgery.

Processed electroencephalogram (EEG) monitors generate numerical values of brain electrical activity. The number provides information about the depth of anaesthesia during surgery, and is used to guide the dose of anaesthetic given. This is to prevent someone receiving either too small or too large a dose of anaesthetics.

#### Search date

The evidence is current to March 2017. We found six completed studies, five ongoing studies, and one awaiting classification.

### **Study characteristics**

All six completed studies were randomized controlled trials (RCT) conducted in 2929 male or female participants undergoing a surgical procedure and aged 60 years or over. An RCT is a study (or trial) which aims to reduce bias when testing a new treatment. The people taking part in the trial are randomly allocated to either the group receiving the treatment under investigation, or to a group receiving standard treatment (or placebo treatment) as the control. RCTs provide the most reliable evidence.

#### **Key results**

Results from three studies (2529 participants) indicate that using the processed EEG to help deliver the optimal depth of anaesthesia could reduce the incidence of POD from 21.3% to 15.2%. Results from three studies (2051 participants) indicate that this could also reduce the incidence of POCD at three months from 9.1% to 6.4%.

#### Quality of the evidence

Processed electroencephalogram and evoked potential techniques for amelioration of postoperative delirium and cognitive dysfunction following non-cardiac and non-neurosurgical procedures in adults (Review) Copyright © 2018 The Cochrane Collaboration. Published by John Wiley & Sons, Ltd.



3

Our review provides moderate-quality evidence that anaesthesia guided by processed EEG indices could reduce the risk of postoperative delirium in patients aged 60 years or over undergoing non-cardiac and non-neurological surgical procedures. We found some moderate-quality evidence that postoperative cognitive dysfunction at three months could be reduced in these participants. There is insufficient evidence supporting the effect on POCD at one week and over one year after surgery or in younger patients.